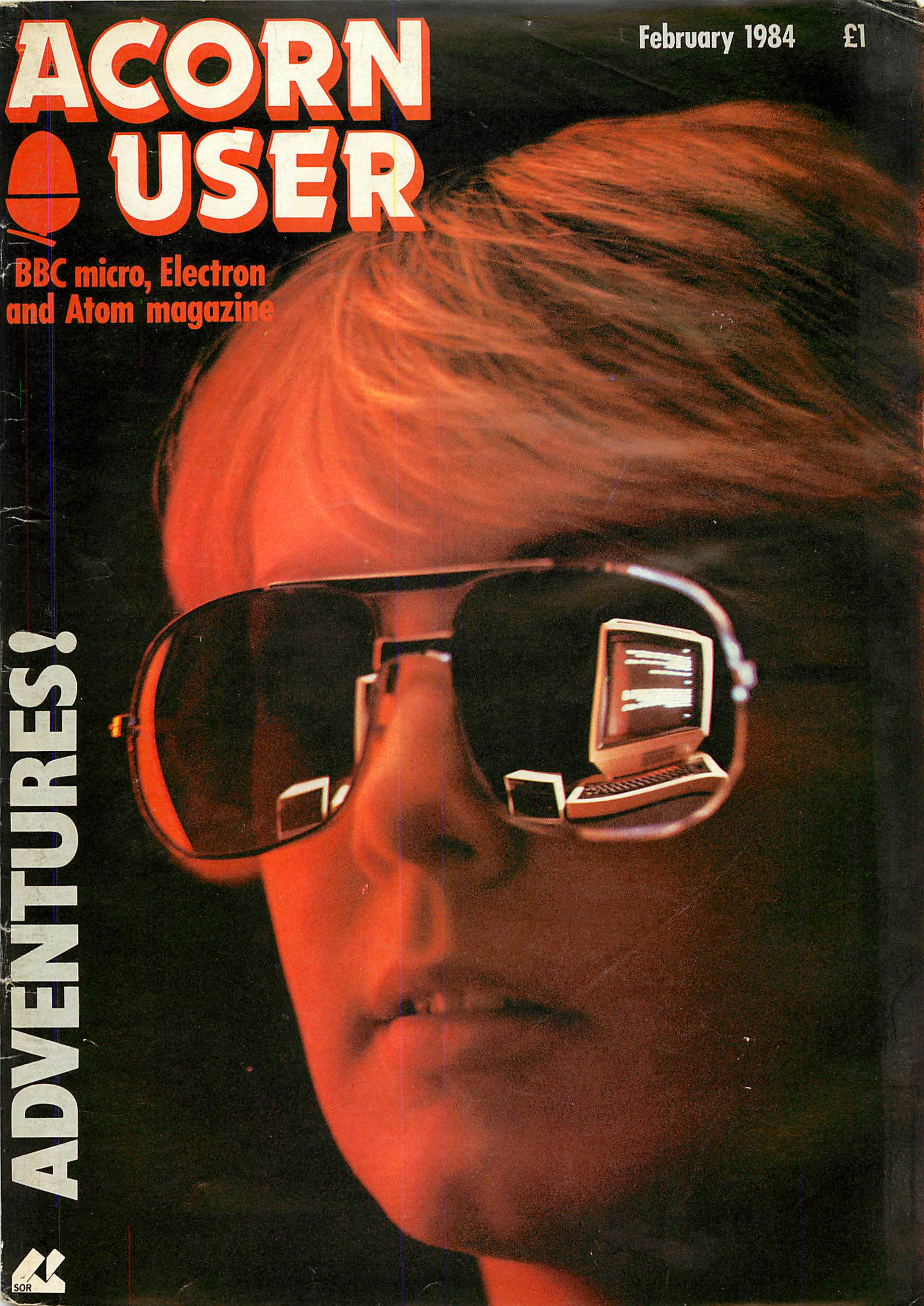
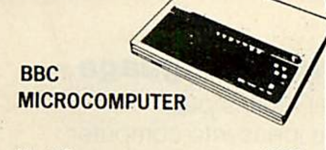

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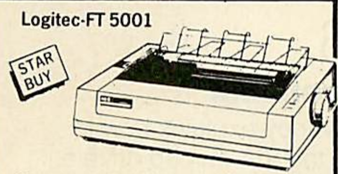
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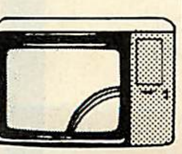
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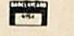
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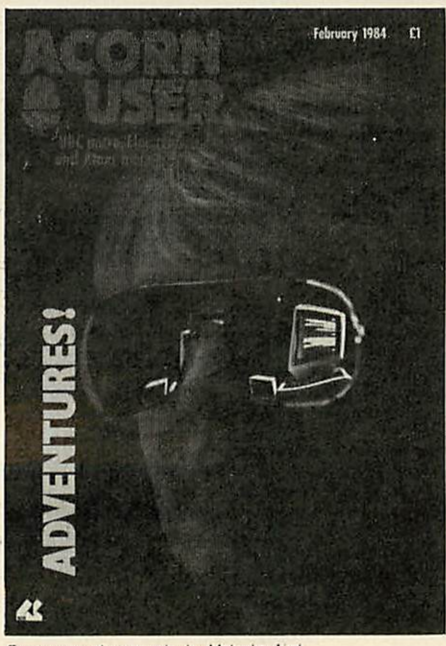


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EMS



Front cover photography by Malcolm Aird

How to submit articles:
You are welcome to send articles to the Editor of *Acorn User* for publication. *Acorn User* cannot undertake to return them unless a stamped addressed envelope is enclosed. Articles should be typed or computer written with double line spacing. Black and white photographs or transparencies are also appreciated. If submitting programs a cassette or disc is vital. Payment is £50 per page or pro rata. Please indicate if you have submitted your article elsewhere. Send articles, reviews and information to: The Editor, *Acorn User*, 53 Bedford Square, London WC1B 3DZ. Tel: 01-631 1636.

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Coming soon in *Acorn User*:

Fractals and recursion:
Susan Stepney goes further into fractals and adds recursion to give the user more control

Filing Systems:
First of series on Acorn's Advanced Filing Systems

Dumps:
George Hill explains how to dump mode 7 and teletext screens

BBC:
Paul Beverley looks at using analogue-to-digital converters for scientific measurement

Printer driver:
Tony Rudkin creates a driver routine which enhances Acornsoft's View

Basic:
How to get the most from Basic 1, by David Barnett

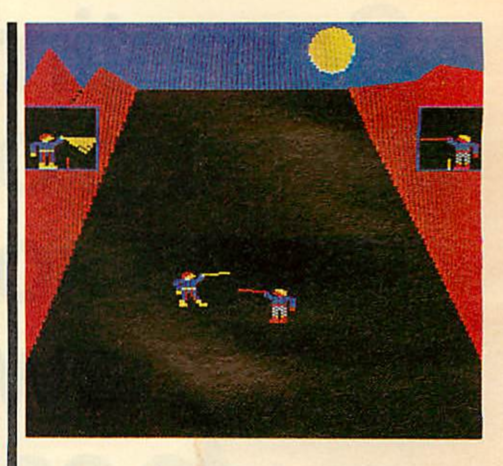
Software Top 20:
Our own chart of the big sellers, and analysis of what's going on.

Authors please note

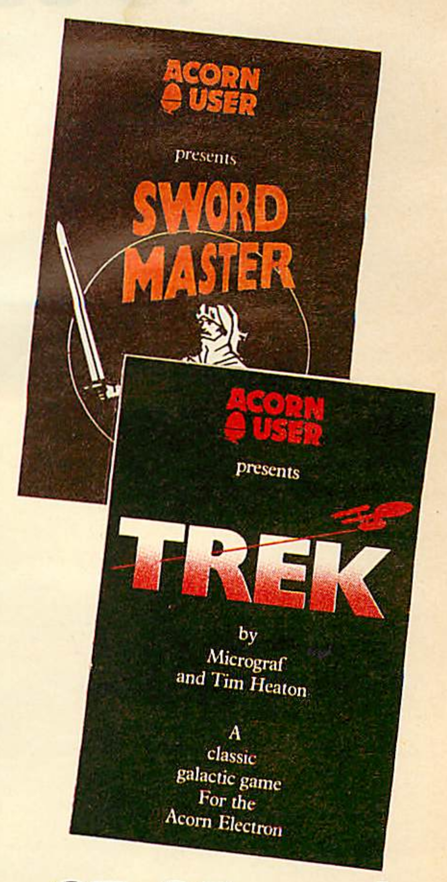
We've been inundated with articles for publication – many of an extremely high standard. It takes time to read them, try listings out and edit them – which is the only way to maintain standards. Also remember that magazines work at least two months in advance.

So please bear with us if you hear nothing for weeks (although all submissions are acknowledged).

Thanks for your patience and apologies for any frustration caused.



Actual screen shot of Swordmaster



£7.95 each

TWO games are now available from *Acorn User.* They are Sword Master (BBC B and Electron) and *Trek* (BBC B and Electron). Both make extensive use of the excellent graphics, speed and sound of the machines. Turn to page 15 for details.

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ISSN: 201-17002 7

Sometimes even the best of friends need something new to say to each other...



"I want

To get that excited feeling back again.
Lots more software. But I can't afford it all the time.
Lots of new programs. I know all mine backwards.
To swap notes with other people who love computers.
To know more about computers. And to use what I know.
Most of all I want my computer to do more!

and I don't want

To have a lot of hassle.
Or spend a fortune.
Or have to tramp for miles to find it all."

Beeb assembly on a 16k EPROM

ASSEMBLER language programmers will appreciate ADE, which combines an editor, two-pass macro assembler and debugger on a 16k EPROM for the BBC.

The ADE package allows use of tabs instead of spaces to separate source code fields, thus reducing the source text. Source and object programs are kept on disc, saving user memory for buffers and the symbol table.

The editor doubles as a line and screen editor and reads files in chunks, which it handles semi-automatically. The assembler accepts standard nmemonics and allows opcodes in lower case, while the debugger permits breakpoints and single-stepping.

ADE costs £60, including VAT, manual and demo disc, from SYSTEM, 12 Collegiate Crescent, Sheffield S10 2BA.

Upgraded to disc

WHO will be first to offer cassette-disc upgrades on programs?, we asked in last month's news. Diamondsoft's answer is its Version 2 software, a series in which three of the company's best-sellers are available: Home Accounts (£13.95), Flexifile (database – £13.95) and Business Accounts (£17.95).

The software is supplied on cassette and will run in a cassette tape or disc environment.

Azerty option

IN A letter published last month a Belgian reader inquired about converting the Beeb keyboard to Azerty. Les Peters of Dataware, Swindon, draws our attention to his company's Languagewise disc, now availble, which operates in conjunction with Computer Concept's Wordwise word processor ROM and the Epson FX-80 printer.

Languagewise enables most European languages (including Flemish and Welsh) to be previewed and printed without using 'lazy' keys, and the Azerty option is available with all of them.

Electron add-on snag

LIKE a fishing boat approaching the quay surrounded by seagulls, the Electron is about to dock but plenty of questions are still up in the air.

The most pressing question mark hangs over its availability, but that should be answered this month. The acute shortage of Electrons evident in the build-up to Christmas will become less marked as alternative sub-contract manufacturers come on stream. In the pre-Christmas period Acorn estimated that demand exceeded supply by about three to one, and where Electrons were on sale reports suggested that only the British stiff upper lip prevented trouble as they rapidly sold out.

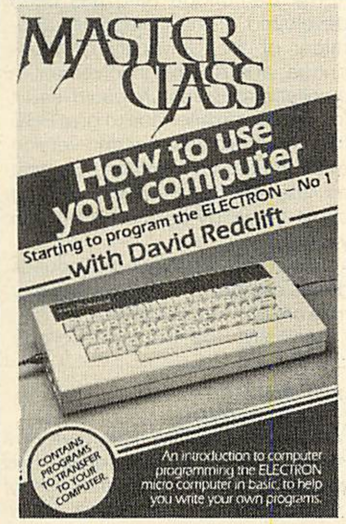
Software is also beginning to appear in some quantity, but early offerings from Acornsoft point to another kind of shortage – the lingering question of when add-ons for the machine will be ready. The documentation with some programs includes provisions for use of joysticks, but there is no indication from Acorn as to when a joystick interface will be ready.

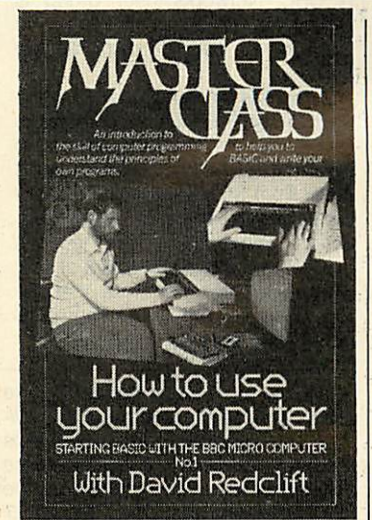
Nor will Acorn commit itself to say when a printer interface will be available.

Since the summer launch of the Electron it has been on the cards that the production of expansion units might be hampered by the more immediate need simply to turn out enough machines to meet demand, and Acorn's experience with promised additions to the BBC micro seems to have made it wary of repeating the mistakes with the Electron.

The first expansion units for the machine will probably come from *independent* suppliers. Sir Computers of Cardiff is advertising plug-in modules to solve the printer and joystick problem and also to allow for the extension of ROM-based software.

It claims that it is less than two weeks away from the first shipments of its interfaces. Its £45 printer/joystick module will give you a Centronics printer interface and the option to use any BBC-compatible joysticks. Its 8k ROM expansion board, due to cost £40, will give you up to 128k with a static RAM facility.





THE RANGE of Master Class video cassettes has now been expanded to cover the Electron as well as the BBC. The latest tapes to be issued are 'Games & Graphics', a separate one for each machine, which teach you how to produce graphics and write your own games. Three small games can be downloaded from the video soundtrack as demonstration pieces. Other computer titles available – the cassettes all cost £19.95 and are sold through all the main retailers – are 'Starting Basic with the BBC Microcomputer (Nos 1 and 2)', 'Starting to Program the Electron (No 1)' and 'The BBC Microcomputer in Primary Education', all with presenter David Redclift (pictured at the keyboard). The tapes last about an hour and all have programs which can be downloaded, thus enabling the viewer to carry out programming exercises between viewing sessions.

Dutch treat for downloaders

MODEM users might like to contact a Dutch group which is an offshoot of the Big Ben outfit.

They spend their time downloading software to and from each other – and not just on BBC micros. Apples, Philips and TRS80 machines have all been contacted. It's even possible to play games on other machines from a BBC!

Hans Doelemam runs the network, and they distribute terminal software free of charge. The address is Hans Doelemam, Fuik 49, 1141CK, Monnickendam, The Netherlands. The phone number from Britain is 010 31 (Netherlands code) 029 95 4284.

New line for Beeb

FIRST prize in a competition featured in the current issue of *Family Circle* magazine is a BBC microcomputer and word processor plus eight programs and tuition from one of Acorn's experts on how to use the system for business, education and game-playing. The hardware, including monitor, disc drive and printer, is worth more than £1,500.

Entrants have to complete the last line of a limerick which starts: 'A busy young housewife named Sue', filling in the coupon in issue 1/84 of *Family Circle*.

Other manufacturers woo BBC

UK MICRO makers are beginning to line up for battle with the prospect of the BBC contract as the prize.

Acorn believes that the renewal of its contract with the BBC, due in October, is a formality but that isn't stopping some of its competitors from making their interest plain.

Sinclair was the first to mobilise and it is insisting that, far from being a formality, the contract should be re-examined and the specification of a future BBC micro re-assessed.

Dragon Data has also made the first moves in what could be a long-running serial. 'We have indicated to the BBC that we would like to be considered for a bid,' said Dragon's sales manager Richard Wadman.

But he added that the ball was in the BBC's court.

Oric has expressed interest more passively: 'We would be delighted to be considered,' a spokesman said.

According to Acorn, a period was put on the original contract to protect both Acorn and the BBC in case the project went on to the rocks. The opposite has happened – the deal has been extremely lucrative for both parties. Acorn argues that the effect of this will be to make renewal a formality. Sir Clive Sinclair may be less easily persuaded.

Hidden winner

THERE were 115 correct entries in our Hidden Message competition (November issue). The answer, Hills Alive, was semaphored on the front cover and on page 22. The winner, picked from a bran-tub of the 115 postcards, was P A Davies of Derby, to whom the prize programs have been sent.

Beeb enters US market

THE BBC micro has been given official approval to be sold in the US. The go-ahead comes from the Federal Communications Commission, which arbitrates on radio emissions and the like, and the Underwriters' Laboratory, which enforces fire and safety legislation.

Acorn's two stands at the Comdex show in Las Vegas were well-attended and units are now being shipped to the States.

London date

THE organisers of the London Home Computer Show have rescheduled the exhibition. Because many potential exhibitors wish to attend the Las Vegas Computer Show, the London show has been postponed for a month and will now take place in the Royal Horticultural Society's Old Hall, Vincent Square, Victoria, Westminster, London SW1 between February 3 and 5.

Admission is £2.50 for adults and £1.50 for children under 15.

Teachers' show

THE Acorn Education Exhibition, aimed at people involved with Acorn computers in education, is to be held at the Central Hall, Westminster, London SW1, from January 25 to 27, 1984.

Invitations have been sent out to more than 45,000 educational institutions throughout the UK and attendance is expected to be above 12,000.

The show is organised by Computer Marketplace (01-930 1612).

Software fair

COINCIDING nicely with half-term on March 2 and 3, the Educational Software Fair will present 45 exhibitors at Dauntseys School, West Lavington, Devises, Wiltshire. Acorn, the MEP and book publishers Nelson, Addison-Wesley, Heinemann and Longmans will be exhibiting and the Turtle and Buggy will be demonstrated.

The organiser is Peter Harris. (Tel: Lavington 2289.)

English angle

A CONFERENCE on the 'The Microcomputer and Creativity in English Teaching' is being mounted by the Birmingham Branch of NATE (National Association of Teachers of English) on March 31.

The conference, taking place at Westhill College, Birmingham, is intended to explore all aspects of teaching creative English with new technology.

Further details: Lorraine Boyce, Westhill College, Selly Oak, Birmingham 29.

On the Z80 race card

SECOND processors for the BBC micro could be available from two sources well before Acorn gets its own add-on boards ready.

In the race to fit a Z80 to the BBC both Torch Computers and Watford Electronics have announced cards that should be in the shops at least two months ahead of Acorn's offering. It also looks as though both of them will be undercutting Acorn's price.

Torch was the first to announce its product, a move that is hardly surprising since it offers a Z80 and CP/M compatibility for the BBC in its Z80 Disc Pack. Watford followed with a card that it expects to have in volume production by the end of January. Acorn was touting its own Z80 card at pre-Christmas shows, but the earliest delivery date quoted was March.

Apart from the processor the Torch card has 64k of RAM, CP/M compatibility in the MCP operating system, the Perfect series of business programs, and an interactive management game. The price will be £375.

Watford's gap-filling add-on has a Z80A running at 4MHz, a 4k monitor EPROM, 64k of user memory, and a double-density disc interface for the BBC. This will set you back about £350.

Acorn's own Z80 second processor has been waiting in the wings for what seems an eternity, and there is still no firm launch date or price for it. Acorn spokesmen hint that it will be less than £400. Like Torch, the company will include some CP/M business software in the package, but this has become such a popular marketing ploy that anybody not giving away software looks positively niggardly.

There could be better news for Acorn in the progress of another long-awaited second processor. The 6502 add-on is expected to be available before the Z80 card, at a price in the region of £175.

National user group for Beeb networkers

A BBC Networks user group is being set up just as the future of Econet has been thrown into the balance.

Acorn is moving towards the Cambridge Ring local area network as the standard networking system for the BBC micro. But that won't deter Tom Short and Mike Taylor of the Bedford College of Further Education, where the finishing touches are being put to a new national user group – they emphasise that the group will include users of any BBC networking system.

The Cambridge Ring has been developed at the Computer Laboratory of the Univeristy of Cambridge, and Acorn's involvement in a collaborative venture could lead it to produce an interface to give BBC micros access to a second version of the Ring. The interface may cost as little as £50, and the new Ring could be ready by the end of the year.

Acorn hasn't signed Econet's death certificate yet, but the day may not be long delayed.

Ironically, the Bedford College where the network user group is taking shape is an Econet user, but instead of waiting for Level 2 it is planning to move to a different type of network.

The aims of the group will be to pool expertise and exert pressure on Acorn, which according to one of the organisers has given its support and has promised to provide speakers for group meetings. Anybody interested in joining should contact Tom Short or Mike Taylor at Bedford College (tel: 0234 45151).

Readers who were baffled by the theory behind George Hill's all-mode graphics dump programs may be relieved to know that some text was left out from page 58 of the December issue. After 'DIM user 3' near the end the article should have read as follows:

It then uses the OSBYTE routine at &FFF4, entered with the accumulator set to &87 to 'read' the character at the current text cursor position. On exit from the routine the Y register contains the value of the current graphics MODE, and this is deposited in the third byte of 'user' by the line

!user=USR (&FFF4)

and read by

mode=user?2

(The use of a DIM statement in a procedure is fundamentally bad practice, as you run the risk of running out of DIM space, which causes an error. If you intend to call the program more than once as a procedure, then both DIM statements should go into the main body of the program.)

PROClimits now sets up the variables as described, depending on the value of 'mode'. It is also simple to include a warning that you are not in a graphics mode at all, preventing the 'hang-up' caused by attempts to dump MODE 3, 6 and 7 screens.

So there it is, the universal dump. Not as fast as a pure machine-code dump, nor as compact as a hybrid Basic machine-code dump, but considerably faster than the Basic dumps, and much more easy to tailor to your needs. You can, for instance, alter the limits for the X% and Y% loops to dump a part of the screen.

Another little trick is to add the lines

lda byte
eor #&FF
sta byte

between

bne one_byte and
jsr printchar (*lines 1210 and 1220*).

```
630 *KEY0"LOAD ""TRAINS2""|M*TAPE|MF.
I%=0TO&1900 S.4:I%!&E00=I%!&1900:N.|MPA
GE=&E00|MLOMEM=LOMEM-~B00|MRUN|M"
631 *FX138,0,128
632 END

1280 FORI=0TO&FF
1290 J=I?&C00:I?&C00=I?&900:I?&900=J
```

***TRAINS* The disc shift routine given for Train Game in the January issue was incorrect. The above lines 630, 631 and 632 should be incorporated into program 1. Lines 1280 and 1290 also need amending as shown.**

***DEFENCECOM* For the Defencecom program we should have pointed out that if you have a disc system the game is too large and has to be shifted down in memory. Setting PAGE=&E00 is not sufficient.**

Genuine slip

HINTS & TIPS last month had the bright idea in 'Flip Slips' to trim your old wire-bound calendar down for use as a book of key-definition strips. Kocher Sparrow of 18 Greek Street, London W1 (tel: 01-437 1672) tore us off a strip for this. They point out that they manufacture a purpose-designed 'Flip-Strip' with 10 pages (a decimal calendar?), costing £1.75 each (including P&P) or £7.45 post free for five.

FLIP·STRIP

"I was pleasantly surprised to receive your parcel yesterday only 2 working days after I first wrote to you – not many suppliers in the small computer market manage such a fast turnaround time."
J.L., London

BBC Microcomputer Upgrade Kits

BBCA2B	Model A to B upgrade kit	69 00
BBC3	Disc interface kit	97 70
BBC3D	Double density disc interface kit	103 45
BBC7	Econet interface kit	70 00
ANB14	Speech interface	55 00

BBC Microcomputer Cables and Connectors

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BBC24	7 pin din pl (cassette int)	0 69
BBC25	6 pin din pl (RGB output)	0 69
BBC26	5 pin din pl (serial int.)	0 69
BBC27	5 pin din pl (Econet int.)	0 69
BBC35S	Data cable single drive	9 77
BBC35D	Data cable dual drive	14 38
BBC36S	Power cable single drive	5 17
BBC36D	Power cable dual drive	6 32



BBC Microcomputers

		Price £ inc VAT
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ANB03	BBC Microcomputer Model B + Disc	498 19
ANB04	BBC Micro Model B + Disc & Econet	545 20

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BBC31S	Single 100K drive	201 25
BBC31D	Dual disc drive 2x100K	362 25
BBC32S	Single 200K double sided drive	258 75
BBC32D	Dual double sided disc drive 2x200K	483 00
BBC34S	Single 400k double sided 80 track disc drive 40/80 track switchable	327 75
BBC34D	Dual double sided 80 track disc drive 40/80 track switchable	603 75

All disc drives supplied with connecting cables, utilities disc and manual

BBC Microcomputer Compatible Floppy Discs

BBC40TS	Single sided 40 track discs Box of 10	17 25
BBC40TD	Double sided 40 track discs Box of 10	28 75
BBC80TD	Double sided 80 track discs Box of 10	36 80

BBC Microcomputer Compatible Monitors

14MON	Microvitec 1431 colour monitor	247 25
12MNON	NEC 12" high resolution monitor Green phosphor	159 85
9MON	NEC 9" high resolution monitor Green phosphor	148 35
STAND	Monitor stand	11 44

BBC Microcomputer Accessories

ANC01	2nd Processor 6502	195 50
ANC04	2nd Processor Z80	339 25
ANE01	Teletext receiver	225 00
BBC45	Pair of joysticks	13 00

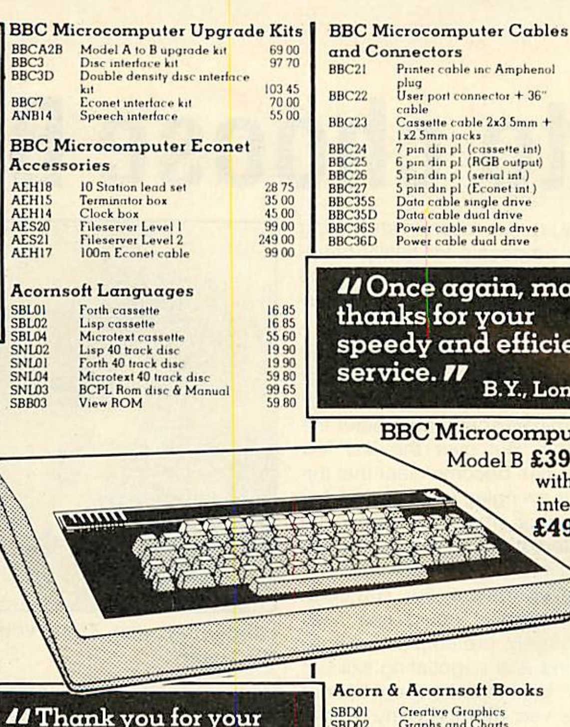
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SBD08	Into View	2 50
SBD10	BCPL Manual	15 00
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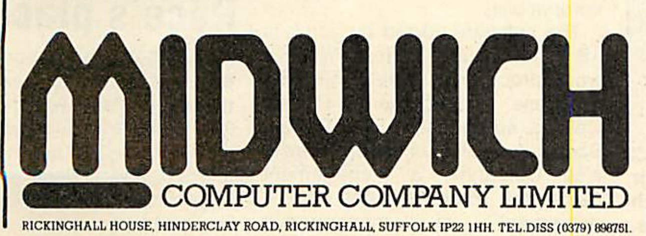
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MPs set to choose Beebs

WHEN Members of Parliament talk about the need to have a good political machine they are usually referring to their local party workers back in their constituencies.

In future, though, more and more MPs could be talking about their BBC micros. For the Beeb is in the running to become an all-party political machine helping our legislators do their job once they've arrived at Westminster.

Already its virtues have been spelled out to a special Commons committee currently investigating the future computing requirements of Parliament.

But now MPs are also being offered a special deal by Acorn for a computer and word processing package – at a significantly reduced price.

The initiative for establishing the BBC as a standard micro for MPs is coming from Labour backbencher Dr Jeremy Bray. A former Junior Minister at the old Ministry of Technology, Dr Bray has been working with generations of computers since the early 1950s and is one politician who at least knows his ROM from his RAM.

He is convinced that with the arrival of the long-awaited Z80 second processor the Beeb will be ideally suited to the needs of MPs whose job often seems a cross between being social workers, legal eagles, public relations experts and general administrators.

Shortly before Christmas he was arguing his case to a parliamentary inquiry which rejoices in the title of the Computer Sub-Committee of the House of Commons Services Committee. For some months now this inquiry has been investigating various proposals for finally bringing the silicon revolution into the wood-panelled precincts of the Palace of Westminster.

At one point it looked as though Parliament was going to lumber itself with expensive mainframes with terminals scattered around the Commons. But over the last few weeks it has become clear that the inquiry is swinging towards the idea of individual machines, and the main interest now is what system or systems it will finally recommend.

However, before the sub-committee reports it could find itself being largely pre-empted, due to the efforts and negotiating skills of Dr Bray. Last autumn every Labour MP received with the party whip a short report from the ex-minister and one-time Fabian chairman on how micros could be used by MPs and their staff. This mentioned the obvious advantages of choosing systems able to use common programs and data and to communicate with each other.

He explained to his colleagues that while low-cost micros have much in common there are usually crucial differences that make program-sharing and communications difficult, if not impossible.

The obvious answer, he argued, was for Members – at least, those of the same party – to have a common system. According to Dr Bray the average MP has four basic requirements from a computer: there should already be a large number of established users; the system should have good communications capabilities including Prestel, telefax and with mainframes; it should be cheap and easy to get a basic system with user-friendly software; and last and most important, the system should be capable of extension to include 8-bit CP/M for business and professional software.


Labour MP Jim Tinn: veteran BBC user

Apart from suggesting it should have a picture of an owl on the front Dr Bray seemed to be presenting colleagues with an identi-kit picture of a BBC with a second processor.

The clincher for a number of Labour MPs was possibly tucked further back in his report. There he disclosed that a deal has been worked out between Acorn and the Labour Party offering them a preferential price. For instance, a Model B with disc interface is available to Labour Members for £378 – compared to about £469 for the rest of us. A complete package, including 800k dual disc drives, a green screen monitor, an Epson FX80 printer and a VIEW chip would cost £1,396.51.

Though the deal at present applies only to Labour MPs, Acorn are clearly willing to come to similar arrangements with the other parties.

Since October, Dr Bray, who is MP for Motherwell South, has fitted himself up two systems, one in his office at the Commons and the other in Scotland. At present, about a dozen of his colleagues are either acquiring Beebs or are already finding them an increasingly essential part of their parliamentary life.

Probably the MP who has been using a BBC micro longest in his everyday work at the Commons is Redcar MP Jim Tinn. Unlike Dr Bray, Mr Tinn does not have a background in computers. A former steelworker sponsored by the National Union of Blastfurnacemen, he is probably far more typical of the majority of MPs who will be finding space on their desks for micros.

His day usually starts in consulting his Acornsoft Diary to see what is coming up, what appointments he has, and what debates he should be preparing for. But the main use is for keeping files on constituency casework and the ever-extending address book that every politician acquires.

The Acornsoft program for names and addresses is particularly appreciated by Mr Tinn – he was able to address 400 Christmas cards in 15 minutes.

With the House of Commons well on its way to having its own BBC user group, another surge of Beeb-owning MPs is expected in March, when the next allocation of cash for secretarial and office facilities is due.


ZYGON PRODUCTS has a range of computer stands designed for the BBC micro system. This is the top of the range, the Delta which offers lots of space for the micro and monitor, plus disc drives, printer, teletext adaptor and Prestel modem and second processor. It can be easily moved and is fitted with cable ties. The range starts at £59 (+ VAT) and this version costs £96 (+ VAT). Contact Zygon on Hoddesdon (0992) 466259.

Disc Pack soft sell

FOR BBC users who can't wait for Acorn to give them the means of turning their micros into business systems, Torch has added to the attractions of its Z80 Disc Pack.

The price of the Disc Pack is now down to £730 (excluding VAT) and software to the value of £1,000 (in Torch's estimate) is thrown in. You still get twin 400k floppies, a Z80 at 4MHz, 64K of RAM, and CP/M compatibility.

The software added by Torch is the Perfect suite: Perfect Writer, a word processor, Perfect Filer, for database management, Perfect Calc, a spreadsheet, and Perfect Speller, a spelling checker. There is also Comanex, a management game that Torch says has the endorsement of management consultants.

Torch had the misfortune to launch this new package just as a controversy began over the suitability of the Perfect range to the UK market. The confusion arose through discrepancies between the user manuals, which Perfect Software Inc had re-written for UK users, and the software – in particular Perfect Filer – which it hadn't. The US software supplier is now anglicising the software to match the manuals.

Pace's place

THE 'Winchester networks' story on page 7 of January's *Acorn User* stated that Pace were the manufacturers of the GSL networking system. In fact, GSL are the manufacturers and Pace the sole distributors for the North of England.

GSL (Geophysical Systems Ltd) can be contacted at 2 North Way, Andover, Hampshire on (0264) 58744 or 51699.



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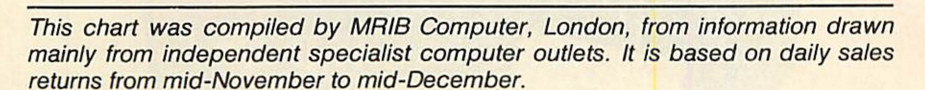
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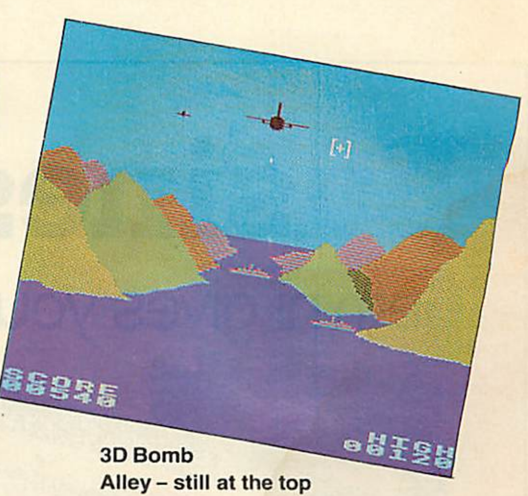
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5 *(2)* 747 FLIGHT SIMULATOR	DOCTOR SOFT	£8.95	£11.95
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*AVAILABLE ON THE ELECTRON


This chart was compiled by MRIB Computer, London, from information drawn mainly from independent specialist computer outlets. It is based on daily sales returns from mid-November to mid-December.



3D Bomb Alley – still at the top

The zappers are keeping their heads down in *Bomb Alley*, still at the top spot, but Postern's *Deep Space* could topple it and give a boost to the manufacturers of 3D spectacles. The question is whether 3D with spex is a nine-day wonder or here to stay. The most dramatic entry is *Chukkie Egg* at number 4 – it wasn't even 'bubbling under' last month. The *747 Flight Simulator* package is losing altitude, now down to number 5, under pressure of competition from other simulations.

Firehawks, up to number 8 from nowhere, looks like realising its popular destiny, and another shooting star is *The Hobbit*, but one can't help feeling that the number 3 position achieved by this text-only adventure is based on its reputation as a Spectrum game with graphics.

Slipping at last, *Planetoids* (née *Defender*) has proved a consistent seller for Acornsoft – it was one of their first issues. Superior Software's *Hunchback* has sustained a bigger fall (from 14 to 20) than one would have expected of this very good version. *Dr Who*'s similar decline is more deserved. It's a messy piece of software that was surely riding only on its TV name.

BUBBLING UNDER: *First Steps with the Mr Men* (MIrrorsoft); *Pure Fantasy* (Superior Software); *Lunar Rescue* (Alligata); *Space Adventure* (Virgin).

Third degree in Acornsoft tests

Six software programs from Acornsoft will give your general knowledge of specialist subjects a searching examination.

Acornsoft drafted in well-known experts to pose the questions on each of the six subjects in the Grandmaster Quiz series: Sheridan Morley on Theatre, Julian Symons on Crime and Detection, Steve Race on Music, John Julius Norwich on History, Brian Aldiss on Science Fiction and Anthony Holden on Royalty.

The Programs, costing £12.65 each, offer no less than 30 quizzes each, with a total of 300 questions that can be answered alone or in a competition of two people or teams. The programs work on the BBC B.

MEP packs WP into schools

An educational word-processing system on a single 16k ROM chip for the BBC micro has been developed in a project partly funded by the Microelectronics Education Programme (MEP).

Described as 'the only word processor designed by teachers for pupils to use', the Edword package is available from Clwyd Technics as a number of packs.

The User Pack comprises a self-instruction guide in the form of a free-standing flip book, a reference manual, a plastic function key strip and the ROM chip; the Teacher Pack consists of teaching guidelines (with suggested tasks), information sheets on word processing with print file generator program, a cassette or disc with prepared print files and specimen documents, plus overhead projector transparencies and wall charts. A Primary Guide Pack will help teachers to explore the potential of word processing within the primary curriculum.

Edword will run on any BBC micro and it can use tape, disc or network as its storage system, and works with any BBC-compatible printer or electronic typewriter.

The Edword development project team was drawn from the North East Wales Institute of Higher Education under the directorship of Peter Weston of the MEP, with graphics design and production by the Clwyd Centre for Educational Authorities in Wales.

Although designed for schools use, Edword contains many features of commercial word processors. Its claimed advantages for educational use are its simplicity of operation, a 'unique' error help facility (with error messages), display of text as it would be printed, and easy formatting.

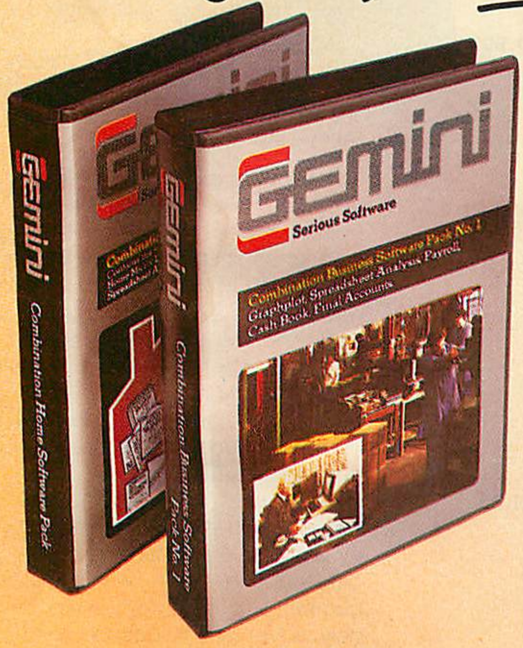
Clwyd Technics plans a February launch for an enhancement to Edword call Edword+, which will work alongside it.

The User Pack costs £38.95; the Teacher Pack £18.95 (cassette) and £21.95 (disc); the Primary Guide £7 and £10; and the Starter Pack £56.95 and £59.95.

Contact Clwyd Technics at Unit 4B, Antelope Industrial Estate, Rhydymwyn, nr. Mold, Clwyd, tel: (035283) 751.

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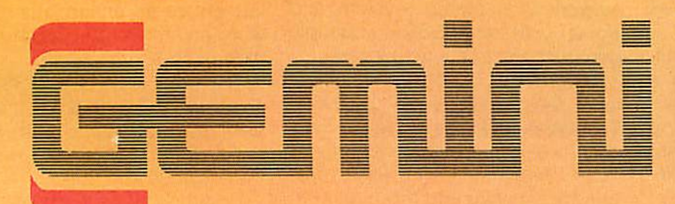
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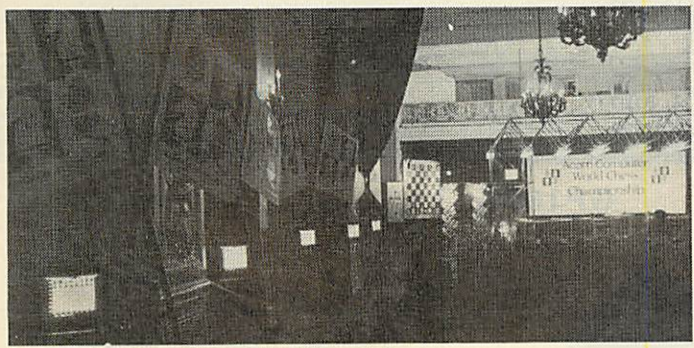


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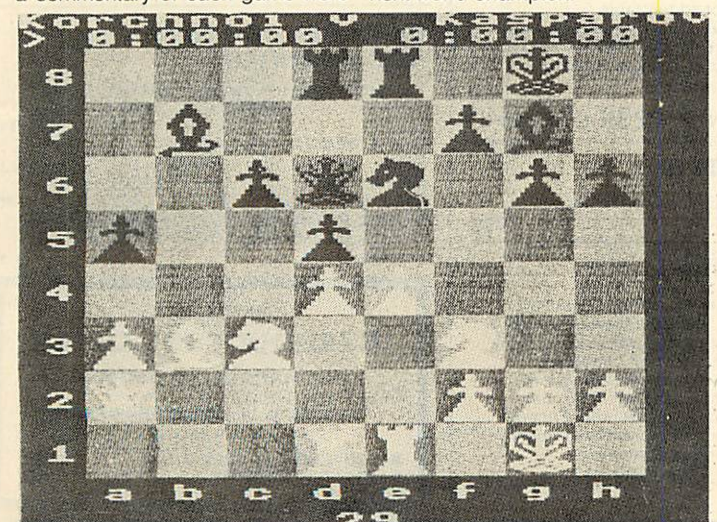
Acorn monitors chessmen

THE Acorn Computer World Chess Championship semi-finals, in which the 20-year-old Russian Gary Kasparov defeated his exiled compatriot Victor Korchnoi, were the first world-class chess tournament to be staged with analysis, reporting and commentary carried out on the spot by computer.

A local area network Econet system of 12 monitors was set up in the main tournament hall at the Great Eastern Hotel, London, so that visitors could follow play. A converted Acornsoft chess game program was used to keep tabs on the players' latest moves and the time taken.

Other monitors supplied the same information to a lecture room, where visitors could hear the game in progress analysed by experts. Three screens in the press centre enabled reporters to communicate all the important moves as they happened to their journals, while a BBC micro word processor drafted telexes and issued press notices. The system also maintained a record of each player's move, to be recalled for the preparation of 200 daily bulletins. These included screen dumps (an example is illustrated below) to highlight the more significant moves.

A visual display of the board and a commentary of each game were displayed on Ceefax, using a BBC and modem to enter each development into their main computer.



Sample dump of critical points of play

Kasparov finds key to the future

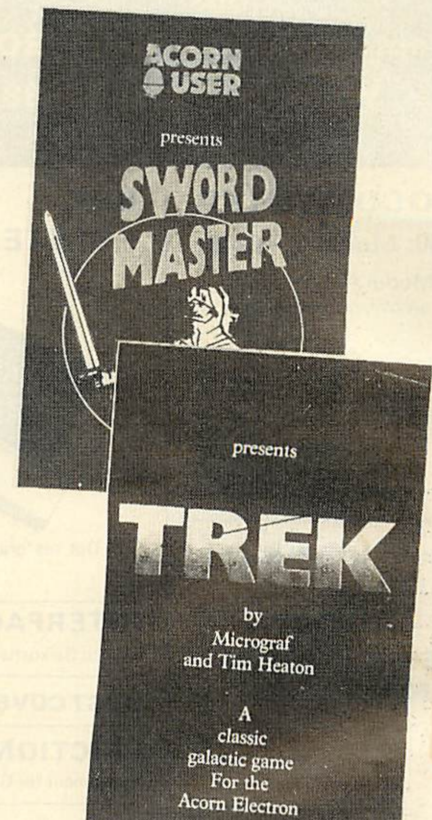
Acorn achieved another first last month when the victorious Kasparov took on ten British teenagers in a simultaneous exhibition match at Acorn Computer's Covent Garden showroom. It was the first time that a Grand Master had played a simultaneous match by computer. A bank of ten BBC micros were used running Acorn's computer chess game.

Kasparov seemed to adapt readily to the on-screen chess board with moves controlled from the keyboard, moving quickly from one monitor to the next.

Most of his young opponents, selected by the British Chess Federation, also found themselves quickly at home with 'soft' chess, although one of them, Susie Walker, had to retire after fainting. She attributed her plight to the persistent flicker of the 'prompt' square on the screen's chessboard.

The score was six points to four to Kasparov, two players having outwitted the man tipped as the next world champion.

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Acorn User presents two high-quality games on cassette for your micro which put you at opposite ends of time. Developed, produced and tested by Micrograf.

Sword Master by Ken Worrall is based on the fencing rules written in 1190 by Herman von Salza for the Deutscritter Order of Teutonic Knights. It features full colour, machine code animation of a sword duel between the players shown on screen as knights.

Full instructions, music, sound effects, player rankings (from greenhorn to Swordmaster) and a roll of honour (which can be saved) and all included. The game also closely reflects the rules, style and dress of the Deutscritter Order.

Trek puts you in charge of a Starship with the task of wiping out an alien fleet. It's an excellent adaptation of the classic game with 7 screen displays, 3 on-board computers and 2 weapon systems.

Versions have been written for BBC micro and Electron to use both machines to their full. The BBC tape uses voice synthesis (if the chips are fitted).

The game has been extensively developed from Tim Heaton's Trek III. It now barely fits into 32k – and the graphics are in mode 7.

More tapes will soon be released.

To: **Acorn User Software, 53 Bedford Square, London WC1B 3DZ.**

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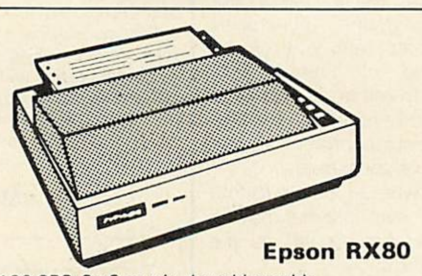
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Beebmon can even run itself. In so doing you can nest Beebmon up to a level limited only by the memory size. Beebmon uses 256 bytes of workspace, located anywhere in memory, even on the 1MHz Bus. Beebmon effectively uses no zero page workspace, so your program (e.g. BASIC) can use any or all of the base page. How does it achieve this? By providing a 6502 interpreter all programs running under it exist in a vertual BBC, so special memory locations like the ROM latch are not actually accessed by your programs, instead they alter a location in Beebmon's workspace. Emulation also allows immediate return to Beebmon command level by ctrl-escape no matter what code is being excuted at the time. All this exceptional power and flexibility is complemented by a clear and detailed manual included in a value for money price of:

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Just look at these features:

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Without a doubt, the most sophisticated DFS Software yet written for BBC Micro Computer.
This powerful new DFS is fully compatible with ACORN DFS yet has much increased power due to additions, carefully designed to make life easier in normal use. It consists of over 14K of efficiently written machine code. It is entirely self contained and so does not require a utilities disc to function.

- The system can either use the ACORN standard 31 files per disc side or DOUBLE THE CAPACITY to 62 files. The size is selected at formatting time. Copying between discs with different catalogue sizes works perfectly normally.
- A FORMATTING PROGRAM is built in, permitting formatting to 35,40,80 track formats with either 31 or 62 files. Since the formatter is built in to the DFS it can be used without affecting whatever program you are using.
- A DISC VERIFIER is also built in. This checks the internal checksums on each sector to identify any corrupted data. This is extremely useful when saving valuable data as it shows faulty discs quickly and easily. Again it does not affect the program you are using.
- A built in DISC SECTOR EDITOR gives a screen window onto the disc enabling detailed editing of any byte on the disc. This is very useful for recovering accidently deleted files and can save weeks of work.
- A double step mode allows the user of 80 TRACK DRIVES TO READ 40 TRACK DISCS. This mode is software selected for each drive individually, thus allowing a 40 track disc to be copied onto an 80 track one very easily. THIS ELIMINATES THE NEED FOR EXPENSIVE SWITCHABLE DRIVES.
- A WORKFILE function sets the name to be used when the null filename is issued. This allows a program to be edited and repeatedly saved having only typed its name once.
- When using LOAD, CHAIN, etc. it is possible to specify an ambiguous filename. This will result in the first file whose name matches the specification being used. This saves typing the end of a filename that you know is uniquely identified by its first few characters.
- Two commands exist to simplify the transfer of programs from TAPE TO DISC. These load the file to &1100, switch off the disc system and then move the file to its correct load address; thus saving a lot of complicated programming. This command can be used to load files up to 27K75 long.
- An advanced COPY command is included which will prompt the user, requesting whether to copy each file.
- RENAME has been extended to allow the use of ambiguous filenames. This allows you to change BERT1, BERT2, BERT3 to FRED1, FRED2, FRED3 with only one command.
- OPENOUT has been improved to give you fewer annoying 'Can't extend' errors, as it automatically picks the biggest space on the disc in which to put a file. A SPACE command lets you know how much space *COMPACT could create before you waste time doing it.
- 2K of RAM can be reclaimed from the DFS by setting "PAGE" to & 1100.

Now with extra features:

- The powerful library system has been extended so that libraries now work on all accesses not only *RUN. This allows you to have a utility directory with all your commonly used programs without muddling in your current workfiles. Very useful for BCPL User.
- Programs can now reside lower in memory by reclaiming some of the DFS' workspaces, indeed PAGE can be taken as low as £1100 under most circumstances.
- To make DFS easy to use, wild cards ("*") have been made vastly powerful, e.g. *INFO *A* gives information on all files in the current directory which have an "A" anywhere at all in their filename.
- Comprehensive and clearly written Manual (available separately) gives the user a complete package deal.
- Fully compatible with BBC TELETEX and TORCH Systems

Continued:

DFS ROM — ONLY **£35**
Complete Disc Interface Kit including DFS ROM and fitting instructions — ONLY £75
Comprehensive and clearly written DFS Manual — ONLY **£7.50**
(P.S. This manual will only be sold to those who purchase our DFS).
P.S. We will exchange your existing ACORN DFS or PACE (AMCOM) DFS for the highly sophisticated Watford's DFS ROM for — ONLY **£30**

DISC DOCTOR — £26

A sophisticated Disc Utility ROM with many useful commands. (For detail description please refer to Computer Concept's advert in this magazine.)

Wordwise

Without doubt a very sophisticated piece of software for the BBC Micro. It has all the features of a professional word processor yet is easy to use.

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NEW DISC-FIX ROM

This ROM is an integrated, menu-driven DISC MAINTENANCE PACKAGE. Using simple menu selections, with intelligible prompts for any input required, the user can recover data from damaged discs. Facilities include:-

- Full screen editing of sectors on the disc.
- Sectors can be found by file name or sector number.
- Files and sectors can quickly and easily be dumped to a printer for examination and possible subsequent modification.
- COPY: blocks of data can be copied from any point on the disc to any other point. Blocks can be as small as one byte and can be transferred anywhere in a sector.
- SEARCH: The disc can be searched for any string, starting and finishing at any designated sector.
- VERIFY: Any block of sectors can be checked for their validity.
- FORMAT: Any track or group of tracks can be individually formatted to Acorn or Watford DFS standard.
- INSERT: Allows the manual creation of new directory entries to allow "undeletion" of files.
- BACKUP: This is similar to normal DFS backup but allows recovery after a disc error. Completely compatible with both Acorn and Watford Disc Filing Systems. Instruction manual supplied.

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VIEW

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N.B. All the above Gemini software is on tape. For Disc Based (40/80 track) please add £3.

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Continued →

EFFICIENT SORTS

Stan Froco helps you choose the right algorithm for the job

OVER the preceding articles I have demonstrated and compared various techniques for overcoming commonly occurring computing problems. I now wish to consider how we go about measuring the efficiency of a particular technique. This leads to a general idea of how to design new techniques that are as efficient as possible.

We want a way of comparing methods that is independent of the language being used and that will give us a measure of how well a particular technique will deal with problems of different sizes. Ideally we ought to be able to predict how long a particular implementation will take to deal with a particular problem. It is useful (and in a commercial environment important) to know whether a problem will be solved in ten minutes, ten hours or ten weeks. For this purpose we have the concept of an algorithm.

Previously I used the term algorithm rather loosely as a synonym for program but an algorithm is really the set of general instructions for solving a problem. For instance, the algorithm to make a cup of tea is:

1. Fill a kettle with water
2. Boil the kettle
3. Put some tea in a warm teapot
4. Pour boiling water from the kettle into the teapot
5. Wait three minutes
6. Put a little milk in a cup
7. Pour tea from the teapot into the cup

This could be translated into a suitable language for controlling a robot. The resulting program would probably be quite long, but the steps it is taking are described in the above algorithm.

The one I am going to use as my example is one I described in the June issue. It sorts integers into ascending order using the very simple technique called bubblesort. Here is the algorithm (below).

```
1. The integers to be sorted are in an array A
2. There are n integers (in array elements A1 to An)
3. FOR i = 2 TO n
4.     j = i
5.     WHILE j > 1 AND Aj < A(j - 1)
6.         swap Aj and A(j - 1)
7.         j = j - 1
```

I have used some computer-type notation (FOR and WHILE loops) as a simple shorthand that is suitable for explaining the steps necessary. You should be able to see how this technique works. Steps 4 to 7 assume that the first i-1 integers have been sorted by the earlier steps. The ith element is then taken and 'bubbled' up into its correct place by comparing it with its neighbour, and swapping them if they are in the wrong order. This continues until they are in order.

Given that it was assumed that the first i-1 integers were sorted, it is no longer necessary to carry on comparing since the rest of the items must be even smaller than the one under comparison. This now means that the first i integers are in order and we can compare the next item. The first value of i used is 2, and so the first i-1 integers must be in order (there being only one of them).

Listing 1 (page 25) shows an implementation of this in Basic. Notice how we have to program around some of the constructs I used to describe the algorithm. There is no WHILE in BBC Basic, so we have to use a REPEAT . . . UNTIL loop and break out when necessary. In addition, BBC Basic has arrays that start at element 0 instead of 1 and so we have to allow for this.

I explained a similar program in the June article.

I ran the Basic program for various sizes of problem. Averaged over five runs each, I obtained the following results:

No. of items	Min time	Max time	Av. time
2	1	2	1.6
4	3	6	4.2
8	13	22	18.8
16	48	61	54.6
32	211	318	249.2
64	727	1,036	941.2
128	3,573	3,899	3,718.2

All times in hundredths of a second

The times cover a considerable range, even for problems of the same size. If we look first at the average times we see that the time taken goes up about fourfold as we double the number of items being sorted. Mathematically we might say:

If sorting x items takes y seconds then sorting 2x items takes 4y seconds.

In fact, we find that in general:

If sorting x items takes y seconds then sorting nx items takes n^2 seconds

This is the same as saying that the time taken to sort is proportional to the square of the number of items being sorted. Mathematically we write:

$t \propto n^2$

that is

time taken is proportional to the size of the problem squared

Commonly programmers talk of the problem being 'of order n squared'.

How we measure the size of a problem is a matter of arbitrary choice. In this case the choice is obvious – we use the number of items being sorted as the size.

It turns out that this is the sort of measure of program efficiency we need. Figure 1 shows in graph form how the time taken varies as the number of items being sorted. You can see how as n (the number of items being sorted) increases, so the time taken increases faster and faster. Clearly the algorithm would be much more useful if it didn't go up so steeply. We would be able to handle much larger problems within a given time.

Most algorithms can have the time they take described in terms of various powers of n added together. However, it is usually the largest power that is important. This is because the terms involving this power grow fastest as n increases (if you double n then an n^2 term goes up fourfold, whereas an n^5 term goes up 32-fold). Figure 2 shows a graph of time against size of problem for various orders of problem. It

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can be seen how beneficial low-order problems can be. Even for a small problem, order n^2 is much worse than $n^{1.2}$. Order n* log n is also shown. This is particularly useful, because although it starts off worse than $n^{1.2}$, for larger problems it becomes smaller, and it is large problems that cause the trouble. These graphs in fact describe the performance of a number of sorting techniques mentioned below.

Could we have predicted that bubblesort would be order n squared? Let us consider the algorithm again. It consists of a loop inside a loop. In the middle of the inner loop is the guts of the algorithm, testing and maybe swapping A_j and $A_{(j-1)}$, and it is this that takes all the time. This is where item i is bubbled into position. On average we expect to bubble this up halfway, ie i/2 exchanges. This is done for every value of i from 2 to n. Thus the number of exchanges taken is:

$$\frac{2}{2} + \frac{3}{2} + \frac{4}{2} + \frac{5}{2} + \frac{6}{2} + \cdots + \frac{n}{2}$$

This is an arithmetic sequence which totals

$$\frac{n(n-1)-2}{4}$$

For large n this is approximately:

$$\frac{n^2}{4}$$

If comparisons and exchanges take all the time (as might be reasonably expected, since the only other things in the program are loop control instructions), then the time will be proportional to this. Removing the constant (which is irrelevant for a proportionality relationship) we find

$t \propto n^2$

This is indeed what we observed.

Not all algorithms are as easy to analyse, but it is useful to be able to estimate what the running time is likely to depend on. Clearly if we work out two different methods we are probably going to prefer the one with the lower order (although for small problems other factors like constants of proportionality, discussed below, may make a higher-order method attractive).

We can analyse a number of sorting algorithms to determine their order. Here are some common ones:

Bubblesort	order n^2
Shell's sort	order $n^{1.2}$
Quicksort	order $n*\log_2 n$
Heapsort	order $n*\log_2 n$

Notice how these have the graphs shown in figure 2. It is important now to look at why we use bubblesort at all. The reason is that we have only so far looked at how the time varies with the size of the problem, not what the actual time taken is for a particular

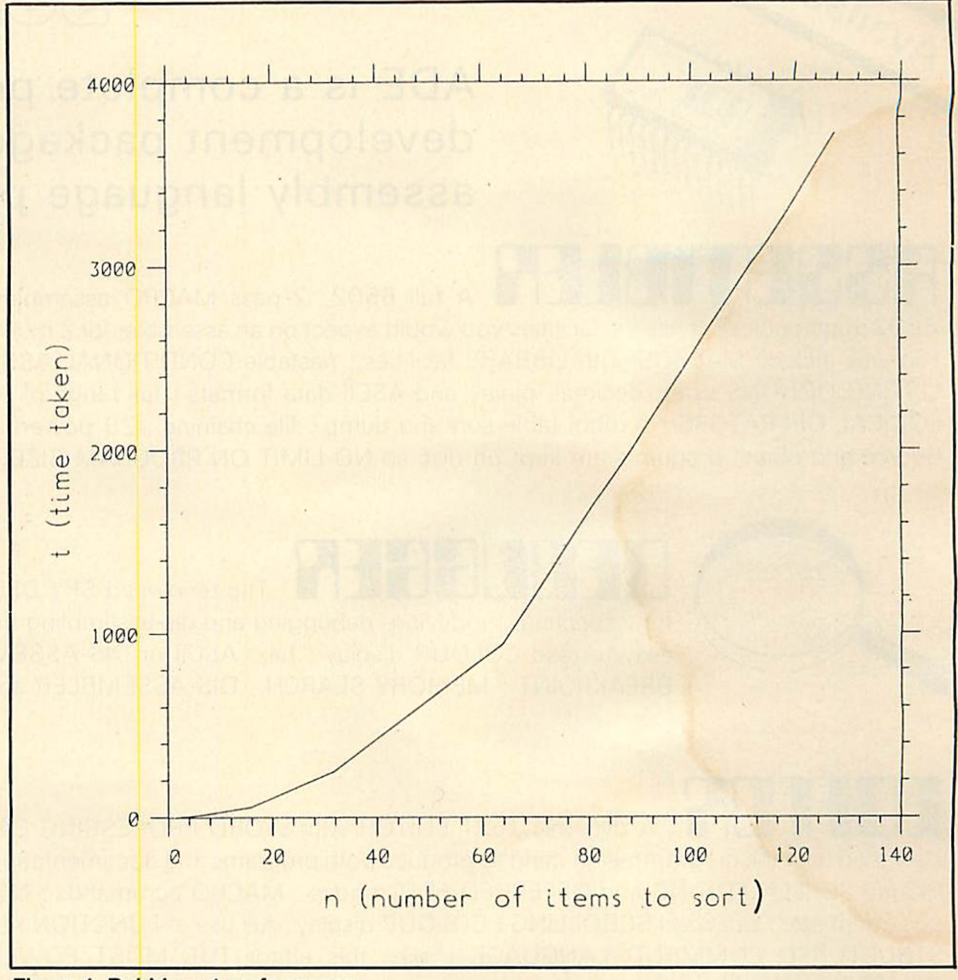


Figure 1. Bubblesort performance

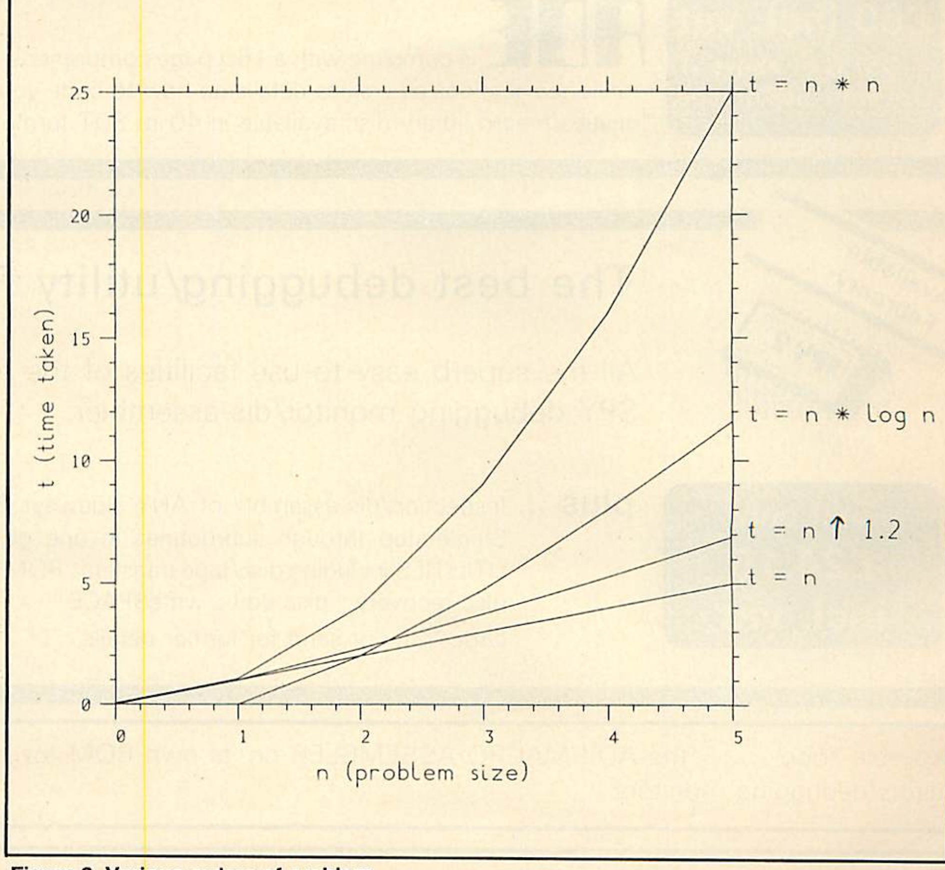


Figure 2. Various orders of problem

implementation. For bubblesort if we write:

$t \propto n^2$

Then we can write

$t = k * n^2$

k being the constant of proportionality. For Shell's sort we can also write:

$t = c * n^{1.2}$

c being the constant of proportionality. We find that in general for a given machine and language c is bigger than k. This means that when n is small (and hence n^2 is small) then bubblesort will be faster. Only for larger problems does the n^2 term matter and make Shell's sort advantageous.

For quicksort and heapsort the constants of proportionality are even larger and make these techniques suitable only for large values of n.

There is a second aspect of efficiency we need to look at. It is often important to know what the worst-case performance of a particular algorithm is. In my analysis of bubblesort I made the assumption that for any particular item A_i the item would on average be bubbled up i/2 places. However, it could be bubbled up i places. If this occurs every time then the problem takes twice as long as the average case. Thus you can see why the maximum and minimum times given above vary so much.

This is a cause of trouble with many algorithms. The quicksort algorithm is extremely popular, since it is simple to implement and fast for large problems. Unfortunately, it has a worst-case performance of order n^2, and with the high constant of proportionality this makes it worse than bubblesort. For this reason Shell's sort or heapsort, where the worst case is about the same as the average case, are sometimes preferred.

The strategy to be used when developing new algorithms is then clear. If the need is for a technique suitable for the largest-possible problem it is vital to use an algorithm with as low an order as possible. If the technique is to be used often on small problems then an algorithm that can be implemented with as low a constant of proportionality as possible is to be preferred.

It helps if you can work out a minimum possible order for a problem. For the sorting problem using pairwise comparisons (ie IF. . . THEN. . . ELSE statements) it can be demonstrated that no algorithm of order less than $n \log_2 n$ exists. Thus it would be foolish to look for a lower-order technique than heapsort for sorting. The analysis of theoretical minima is usually complex, but if it can be calculated it may save a lot of wasted programmer effort looking for impossible algorithms.

The analysis of efficiency is a complex and unfortunately mathematical subject. It is usually covered well in the more advanced textbooks, of which Aho, Hopcroft and Ullman's book *Data Structures and Algorithms* is about the simplest. The definitive work is D E Knuth's *The Art of Computer Programming*, the three volumes of which are all very mathematical but suitable as reference books.

Techniques will be back in a few months with a range of new problems to be considered. If you have a burning problem to solve please send it in and I will try to include techniques that will be of assistance. ●

```
 10 REM Bubble sort
 20
 30 INPUT "Number of items to sort: " size%
 40
 50 DIM a%(size%)
 60
 70 FOR i% = 0 TO size%
 80     a%(i%) = RND(size%)
 90     NEXT i%
100
110 now% = TIME
120
130 PROCbubble(size%)           :REM bubblesort
140
150 tottime% = TIME - now%
160
170 FOR i% = 0 TO size%
180     PRINT a%(i%)
190     NEXT i%
200
210 PRINT "Time taken: " ; tottime% ; "centiseconds"
220 END
230
240 REM*************************************************************
250 REM*
260 REM*  Bubblesort n% items held in an array a%
270 REM*
280 REM*************************************************************
290
300 DEF PROCbubble(n%)
310 LOCAL j%, k%, t%
320
330     FOR j% = 1 TO n%
340
350         k% = j%
360
370         REPEAT
380             REM If in correct order break out of loop
390             IF a%(k%) > a%(k% - 1) THEN UNTIL TRUE :
                GOTO 480
400
410             REM Else swap and repeat
420             t% = a%(k%)
430             a%(k%) = a%(k% - 1)
440             a%(k% - 1) = t%
450             k% = k% - 1
460         UNTIL k% = 0          :REM Can't bubble further
470
480     NEXT j%
490
500 ENDPROC
```

Listing 1. Implementation of the bubblesort algorithm



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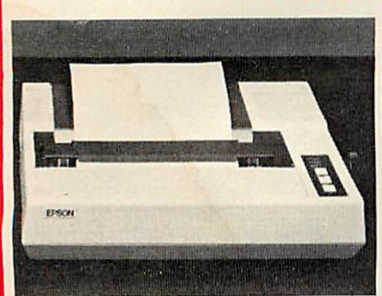
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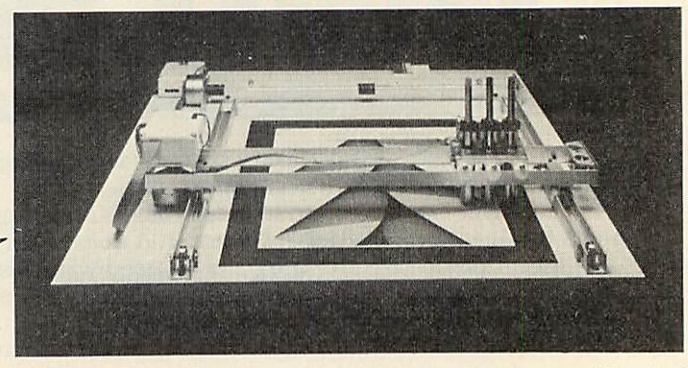
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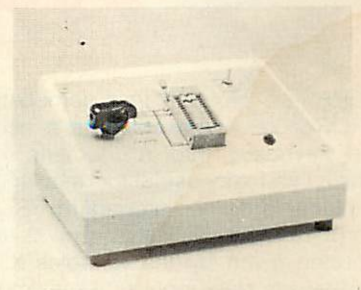
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KEY NUMBERS

Simon Berry puts a numeric keypad at the Beeb owner's fingertips

HERE is a program that demonstrates a PROCedure which converts a section of the keyboard into a 'numeric keypad' which I find very useful for data input.

When called, the procedure, PROCnumber(X,Y,L), places the cursor at the TAB position given by the variables X and Y, and awaits data input of a maximum of L characters. This makes it easy to use in programs with tabular-type input that require a precise placement of the cursor.

In addition it inactivates the whole keyboard apart from the following keys:

7 8 9 0
U I O
J K L

these keys being made to return the following digits:

7 8 9 0
4 5 6
1 2 3

thus forming a fairly standard numeric keypad. In this situation the keys 7, 8, 9, 0 and the full-stop return their normal values while U, I and O return 4, 5, and 6, and J, K and L return 1, 2, and 3 respectively.

Some users may wish to disable the '0' key and enable the comma to return the ASCII value for zero (48), to give the following layout:

7 8 9
4 5 6
1 2 3
0

This can easily be done once the workings of the program are understood. This is how it works:

Line 30 calls PROCnumber giving the variables X, Y and L the values 20, 10 and 10 respectively, and passes program control to line 9000.

Line 9000 starts the PROCedure definition, the variables X, Y and L are allocated the values 20, 10 and 10 respectively, and the variables B and B$ are declared as LOCAL.

Line 9005 empties the keyboard buffer.

Line 9010 releases both SHIFT and CAPS LOCK and then resets the CAPS LOCK.

Line 9020 places the flashing cursor at position X, Y (20, 10) on the screen.

Line 9030 makes the string A$ a null string. It is in the A$ that the number input is returned to the main program.

Line 9040 makes the string B$ a null string. The computer then waits for a key to be pressed and the ASCII value of the character pressed is placed in B.

Line 9050 makes a BEEP and returns control to line 9040 if the DELETE key is pressed before there is anything to delete.

Line 9060 deletes the last digit of A$ should the DELETE key be pressed, and modifies A$.

Lines 9070 to 9100 check the ASCII values returned by the keys pressed and modify these where necessary.

Line 9110 guards against the RETURN key being pressed and control being returned to the main program before data has been input.

Line 9115 returns control to the main program when the RETURN key is pressed following data input.

Line 9120 BEEPs and returns control to line 9040 when an invalid key is pressed.

Line 9130 BEEPs and returns control to line 9040 if the length of the number (in characters – remember the decimal point is regarded as a character) exceeds that specified by the variable L.

Line 9140 PRINTs on the screen the character as specified by the ASCII value B.

Line 9150 adds this character, which will be a single digit or decimal point to A$.

Line 40 gives "variable" the value of the number represented by A$.

Line 50 PRINTs out the value of "variable".

This PROCedure can be used for inputting dates in numeric format using the decimal point as the separator, ie, 23.12.83; however, I prefer to enable the SPACE BAR for this purpose. This can be done by adding the following line:

```
9105 IF B=32 THEN 9130
```

In this case L would require the value 8 and line 40 would read:

```
40 date$=A$
```

To avoid confusion I have stuck pieces of paper on the front face of the keys of the 'numeric keypad' indicating the digit they generate.

This gets over the problem of data input while running programs, but what we want now (Ian Birnbaum please take note) are two machine code routines that could be called by pressing user-defined keys, one to transform the keyboard in the way described here and the other to return it to normal, to be used *during* program development. Any ideas? ●

```
    5 REM PROCnumber
   10 REM by S and D Berry.
   20 CLS
   30 PROCnumber(20,10,10)
   40 variable=VAL(A$)
   50 PRINTTAB(9,15)"variable = ";variable
   60 END
   70
 9000 DEFPROCnumber(X,Y,L):LOCALB,B$
 9005 *FX21,0
 9010 ?&25A=&30:?&25A=&20
 9020 PRINTTAB(X,Y);
 9030 A$=""
 9040 B$="":B=GET
 9050 IF B=127 AND A$="" THEN VDU7:GOTO9040
 9060 IF B=127 THEN A$=LEFT$(A$,LEN(A$)-
1):VDU127:GOTO9040
 9070 IF B>=74 AND B<=76 OR B=79 THEN B=
B-25:GOTO9130
 9080 IF B=85 THEN B=52:GOTO9130
 9090 IF B=73 THEN B=53:GOTO9130
 9100 IF B=46 OR B=48 THEN 9130
 9110 IF B=13 AND A$="" THEN VDU7:GOTO9040
 9115 IF B=13 THEN 9160
 9120 IF B>57 OR B<55 THEN VDU7:GOTO9040
 9130 IF LEN(A$)=L THEN VDU7:GOTO9040
 9140 VDUB;:B$=CHR$(B)
 9150 A$=A$+B$:GOTO9040
 9160 ENDPROC
```

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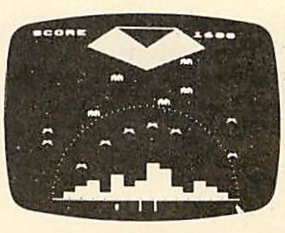
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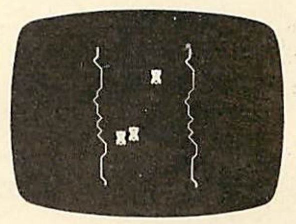
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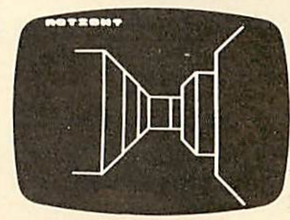
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HANCOCK'S HALF-HOUR

Here's a dozen simple graphics programs by Simon Hancock for the BBC micro and the Electron. Just type them in and see what happens

```
10VDU23,255,255,255,255,255,255,255,
255,255
20MODE2
30COLOUR RND(16)
40PRINTCHR$(255);
50GOTO 30
```

```
10MODE2
20FOR X=0 TO 1024 STEP 4
30GCOL0,RND(15)
40PLOT5,1280,X
50MOVE0,X+4
60NEXT X
70GOTO 10
```

```
10MODE2
20FOR X=0 TO 1024 STEP 4
30GCOL RND(255),RND(16)
40PLOT5,1280,X
50MOVE0,X+4
60NEXT X
70GOTO 10
```

```
10MODE2
20A=RND(1200):B=RND(1024)
30C=RND(200)
40GCOL RND(255),RND(16)
50MOVE A+C,B
60FOR D=0 TO 2*PI+0.05 STEP 0.05
70MOVE A,B
80PLOT5,A+(C*COS(D)),B+(C*SIN(D))
90NEXT D
100GOTO 20
```

```
10MODE0
20A=640:B=512
30C=500
40MOVE A+C,B
50FOR D=0TO 2*PI+0.02 STEP 0.02
60MOVE A,B
70PLOT 5,A+(C*COS(D)),B+(C*SIN(D))
80NEXT
```

```
10MODE2
20FOR X=0 TO 255
30FOR Y=0 TO 15
40MOVE 200,200
50MOVE 1000,200
60MOVE 600,800
70GCOLX,Y
80PLOT85,200,200
90NEXT Y
100NEXT X
```

```
10MODE0
20VDU19,1,3,0,0,0
30VDU19,128,4,0,0,0
40FOR Y=0 TO 1200 STEP 10
50MOVE 640,0
60PLOT5,0,Y
70NEXT Y
80FOR X=0 TO 1300 STEP 10
90MOVE 640,0
100PLOT5,X,1200
110NEXT X
120FOR Y=1200 TO 0 STEP -10
130MOVE 640,0
140PLOT 5,1280,Y
150NEXT Y
```

```
10MODE2
20A=640:B=512
30MOVE A,B
40FOR X=1280 TO 0 STEP-4
50GCOL0,RND(16)
60PLOT5,X,1024
70MOVE A,B
80NEXT X
90MOVE A,B
100FOR Y=1024 TO 0 STEP-4
110GCOL0,RND(16)
120PLOT5,0,Y
130MOVE A,B
140NEXT Y
150FOR X=0 TO 1280 STEP4
160GCOL0,RND(16)
170PLOT5,X,0
180MOVE A,B
190NEXT X
200MOVE A,B
210FOR Y= 0 TO 1024 STEP 4
220GCOL0,RND(16)
230PLOT 5,1280,Y
240MOVE A,B
250NEXT Y
260END
```

```
10MODE2
20X=RND(1200):Y=RND(1000)
30Z=RND(16):A=RND(200)
40MOVE X,Y
50MOVEX+200,Y
60GCOLA,Z
70PLOT85,X+200,Y-200
80MOVE X,Y-200
90GCOLA,Z
100PLOT85,X,Y
110GOTO 20
```

```
10MODE2
20GCOL0,RND(16)
30PLOT5,RND(1200),RND(1024)
40GOTO 20
```

```
10MODE2
20GCOL0,RND(16)
30PLOT69,RND(1200),RND(1024)
40GOTO 20
```

```
10MODE2
20X=RND(16):GCOL50,X
30PLOT85,RND(1200),RND(1024)
40GOTO 20
```



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FILING ORDER

Joe Telford offers practical help in random access filing on disc

RANDOM access filing on the BBC micro does of course require a disc drive as only these have the necessary speed. We create a random access file in much the same way as a tape file, but random access allows any piece of information in the file to be reached whenever we wish, simply by moving to it and INPUT#ing it from disc or PRINT#ing it to disc. Any type of file on disc can be opened for random access, be it Basic program, machine code or data. There are three file access commands:

- Channel=OPENOUT(name$)
- Channel=OPENIN(name$)
- Channel=OPENUP(name$)

OPENOUT is normally regarded as the one to use when PRINT#ing information to a file. Unfortunately, a problem exists with OPENOUT, that is not immediately obvious. If a file exists and we use OPENOUT to allocate it as a writing channel, the first thing OPENOUT does is to erase the file, and reopen it as an empty file. This can cause problems!

We should therefore only use OPENOUT when creating a random access file, and then always use OPENUP, which opens the file for read/write operations. In the first issue of BBC Basic, OPENUP did not exist (see box). Readers with this Basic I should replace any OPENUP commands with OPENIN (the token in Basic is the same).

The PTR# pointer is used by BBC Basic to move to any data we might wish to read from disc, or rewrite to disc. Every file is regarded as a sequence of bytes or characters, starting at byte 0 and extending to the limit of the file (figure 1). This limit can be found using the keyword EXT#, which returns the size of the file nominated. For example:

```
file=OPENUP("D.goods")
PRINT EXT#file
```

will print the size of the file called 'D.goods'. Files must always be closed, to prevent later errors, so if direct commands are used as above we must add:

```
CLOSE#file
```

to close the D.goods file, or

```
CLOSE#0
```

to close all files. The BBC micro can handle up to five open disc files at the same time. We may move the file pointer to any place in the file. For example:

```
PTR#file=200
```

will move the pointer for the file nominated to the byte numbered 200 of the file, so any INPUT#ing or PRINT#ing will then be done from that point. Also,

```
PTR#file=PTR#file+200
```

will move the pointer forward a further 200 bytes. This is particularly useful when moving from record to record. The pointer can also be moved backwards through the file by a command such as:

```
PTR#file=PTR#file−200
```

It is possible to move the file pointer beyond the boundary of the file, depending on the free disc space after the file. For example:

```
PTR#file=EXT#file+1
```

will often work, but is not recommended, as further INPUT#ing will lead to error messages, and the original file structure can be altered. It is always best to ensure that any INPUT# or PRINT# from and to a record is permitted, and is within the bounds of the file. A suitable check when working near the end of a file might be:

```
IF (PTR#file+recordlength) < EXT#
channel PROCdotask
```

The fastest method of reading from disc is by using INPUT#, and similarly the quickest way of writing to disc is PRINT#. There are, however, two other commands for read/write operations: BGET# and BPUT#. Both allow flexible file handling with single bytes.

A record is simply a collection of fields of data, and so the fastest way to place one on disc is to PRINT# it. For example, we might place a three-record field on disc with the commands:

```
PRINT#channel,"SMITH"
PRINT#channel,"JOHN"
PRINT#channel,"312319"
```

The result is that the record is laid down in the file in a particular way, as shown in figure 2. One odd thing about records PRINT#ed to disc is that although the fields are in the correct order, each field is saved in reverse; so for example SMITH becomes HTIMS. The second thing is that each field is prefixed with a two-byte long code marked 't' and 'l' in figure 2. The 't' indicates the type of field, string or numeric, while in string fields, 'l' is the length of the actual string making up the field. So, in figure 2, we would find that 't' and 'l' take the following values:

field 1 t=0 l=5
field 2 t=0 l=4
field 3 t=0 l=6

The length of the record is therefore 5+4+6+(3*2)=21 bytes. There is a problem associated with random access files, which is simply: 'If all the fields and hence all the records have different lengths, how can we move randomly through the file?'

Another problem is in how we can guarantee *not* to overwrite part of a record when the previous record is being added to. In an address book application, this might, for example, occur with a change of address. Where the new address is longer than the original, the new record will also be longer, and so the end of the new record will be written over the beginning of the next.

The answer is to create an empty file before entering any data. At this point the fields can be set to their maximum expected widths, by filling them with spaces. Having done this we will need to ensure that:

- no field ever exceeds its initial width;
- any field rewritten to disc is padded with spaces up to the original field width.

To do this with an initial field size of say 20, we use a simple algorithm:

```
PRINT#file,field$+STRING$(20-LEN
(field$)," ")
```

The benefit of setting the field widths is that we can move through the program in any direction, or at random, referring only to the record length, which is now constant. This record length must be calculated early in the program, by adding the widths of all the fields together and then adding a further two bytes per field for the 't' and 'l' bytes inherent in the PRINT# system of writing to disc.

The task of setting up and using the field headings and widths is not only the pro-

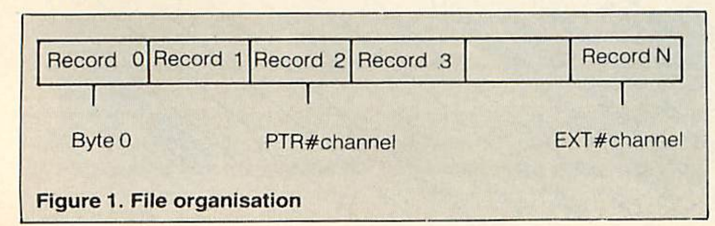


Figure 1. File organisation

t	l	H	T	I	M	S	t	l	N	H	O	J	t	l	9	1	3	2	1	3

Figure 2. Record PRINT#ed to disc

vince of the random access file (RAF) creation program. Indeed, the information will be used in all the random access programs designed to use a particular data file. These headings may therefore best be kept on disc in a 'heading' file, which each program can open and use. The benefit of this is that we can generate general purpose routines to handle the field headings which can be applied to any filing. The heading file, because it is so short (simply a list of fieldnames and widths) can be written as a sequential file which is read from disc into two lists:

- a string list for field names say 'fieldname$(. . .)'
- a numeric list for field widths say 'size(. . .)'

The only problem in making a heading file is one which will recur continually with disc filing. There is always the problem that we might use a disc containing a file of the same name as one we wish to create. This can be checked for by using the OPENIN command. If it returns 0, the file does not exist; any other number indicates the file does exist. In this last case we would want to abort any overwriting which might otherwise take place. The heading file creation listing (program 1) covers this in line 110.

Before examining routines for handling random access files, we should look at some simple ground rules which will make disc filing easier.

First, keep only the files for one application on one disc. This will mean having a disc with only a heading file and a random access file.

Second, try to keep the program files for an application on another disc. (If only one disc drive is available then data and program files will have to reside together on the disc, providing space allows.)

Third, name each file sensibly. For example, D.GOODS is an indication that a file lists articles, while $.AMEND is a Basic program to amend a random access file. There's nothing worse than coming across a disc marked 'file 1' six months after it was created.

Next, once a file is created, make a back-up. Repeat this whenever any work is done with the file.

Fifth, in the early stages of random access filing, regular printouts of the entire file will be useful for diagnosis of problems.

Finally, always make the file as large as it can ever be, to save programming effort if the file must be expanded.

To create and use a random access data file we must be able to read the heading into the two lists mentioned previously. Program 2 shows a useful procedure along with its calling line.

The lists are obviously global variables, as also is the variable 'fields'. This routine will be used in the *random access programs* which follow, but for brevity only the first line will be shown.

Finding the *record* length is an important technique also which will be used in many programs. It is demonstrated in Program 3. In future listings it too will only be shown by its first line.

As previously mentioned, the file pointer can be moved anywhere. We often need to move it to the beginning of a record, and so need a short routine to select a particular record number. In the application we will examine, the first item of every record is a code number, which is in fact the record number. We can move to any record in the file by entering a record number using program 4. If we multiply the record number by the record length, the result is the position of the start of that record. Notice that the first record must be numbered 0 because the file pointer must start at 0. In addition, the record selected cannot be greater than the last one in the file. This possible *error* is checked by line 3260.

For creating a random access file we have chosen a stock filing application, using 50 records. Each record has nine

Program 1. Creating a heading file

```
100 name$="D.heading"
 110 IF OPENIN(name$)=0 PROCsave(name$):END
 120 PRINT'''"File: "name$" : exists,"
 130 PRINT'"Please change disc then rerun."
 140 CLOSE#0
 150 END

1000 DEFPROCsave(name$)
1010 channel= OPENOUT(name$)
1020 READ records:PRINT#channel,records
1030 FOR record = 1 TO records
1035  READ fieldname$,size
1040  PRINT#channel,fieldname$,size
1050 NEXT
1060 CLOSE#channel
1070 PRINT"done"
1080 ENDPROC
2000 DATA 9,Product Code,4,Item name,20
2010 DATA Quantity,4,Re-order level,3
2020 DATA Supplier,20,Address Line 1,20
2030 DATA Address Line 2,20,Address Line 3,20,Phone,11
```

Program 2. To read the heading file

```
   20 PROCload("d.heading")

 2000 DEFPROCload(name$)
 2010 LOCALfile,field
 2020 file=OPENIN(name$)
 2030 INPUT#file,fields
 2040 DIM fieldname$(fields),size(fields)
 2050 FOR field = 1 TO fields
 2060   INPUT#file,fieldname$(field),size(field)
 2070 NEXT
 2080 CLOSE#file
 2090 ENDPROC
```

```
   50 reclength=FNsize

 3100 DEF FNsize
 3110 LOCALfield,len:len=0
 3120 FOR field = 1 TO fields
 3130   len=len+size(field)+2
 3140 NEXTfield
 3150 =len
```

Program 4. Record selection routine

```
   60 no=FNwhichrecord(reclength)

 3200 DEF FNwhichrecord(reclength)
 3210 LOCALrecno
 3220 REPEAT
 3230   CLS:PRINT"File: "name$
 3240   PRINT'fieldname$(1)" (";size(1);
" chars) ";
 3250   INPUT ") "recno
 3260 UNTILrecno>-1 AND (recno*reclength+rec
length) <=EXT#file
 3270 =recno
```

Program 5. Creates an empty RAF

```
  100 ON ERROR REPORT:CLOSE#0:END
  110 PROCload("heading")
  120 CLS:PRINT'"Creating Random access file ";
  130 name$="D.goods":PRINTname$
  140 PROCcreatefile(name$,50)
  150 PRINT''"done"
  160 END

 2000 DEFPROCload(name$):REM as in fig6

10200 DEF PROCcreatefile(name$,records)
10210 LOCALfile,record,field
10220 file=OPENOUT(name$)
10230 FOR record=1 TO records
10240   FOR field=1 TO fields
10250     PRINT#file,STRING$(size(field)," ")
10260 NEXT,
10270 CLOSE#file
10280 ENDPROC
```

fields, and these fields are sized and named in the datafile 'D.heading' we created in program 1. Our task now is to make a random access file called 'D.goods'. Initially it will contain 50 empty records in which all the fields contain spaces. Program 5 creates the empty file. Provided the heading file has been previously created, altering line 130 to change the filename of the random access file and line 140 to alter the maximum number of records envisaged will enable this program to work with a multitude of applications.

There are two main ways in which data can be entered into our empty file. The first is to place each field into a data statement, then add a routine to transfer it to the random access file. The second is to enter information from the keyboard direct to the RAF, remembering that we would in a real application have to validate each field entered, and check the number of characters entered in case they exceed the field width. Consideration must also be given to screen forms design, particularly if the information will not be entered by the programmer.

Program 6 handles the record entering. Its main body shows the routines called, many of which we have seen previously. Three particular routines of interest are the 'ok', 'writerecord' and 'getrecord' routines.

The 'ok' routine is used twice by the program. It prints a prompt string, then returns 'Y' or 'N', depending on keyboard response. It is useful in deciding whether to continue or exit from a loop, as in line 200.

The 'writerecord' routine simply moves the file pointer to the start of the record and PRINT#s the most recently entered record to disc. The record is contained in separate fields, in the string list 'field$(. . .)' which is set up in line 120. This routine will take the records in any order.

The 'getrecord' routine is the most difficult to code, and uses the INPUT statement to allow keyboard entry of each record. The early part of the routine (lines 4000 to 4040) is concerned with entering the record number into the field information list. Lines 4050 to 4090 deal with entry of the other fields, and in particular line 4080 pads each field to its maximum width, as set by the 'size(. . .)' array. Line 4100 allows a primitive form of validation, as the operator can visually check the entries before confirming that they are fine, or can repeat the whole record. Finally, error trapping protects against leaving open files during the debugging stages of the program.

Using the routines above, we are able to enter records into the data file. We are now also capable of creating data files for other applications, using the concept of a heading file, and a general purpose RAF creation program. It then becomes important to check our work by printing out part or all of the file. In any file printing program, the decision as to which fields are printed is in the hands of the programmer, and so this

Program 6. Enters records

```
  100 ONERROR REPORT:CLOSE#0:END
  110 PROCload("heading")
  120 DIMfield$(fields)
  130 reclength=FNsize
  140 name$="D.goods"
  150 file=OPENUP(name$)
  160 REPEAT
  170  no=FNwhichrecord
  180  PROCgetrecord(no)
  190   PROCwriterecord(no,reclength)
  200 UNTIL FNok("Another record? Y/N")="N"
  210 CLOSE#file
  220 PRINT''"done"
  230 END

 2000 DEF PROCload(name$):REM as in fig6

 3100 DEF FNsize:REM as in fig7

 3200 DEF FNwhichrecord(reclength):REM as
in fig 6
 4000 DEF PROCgetrecord(no)
 4010 LOCALfield
 4020 REPEAT:CLS:PRINT"File: "name$
 4030  PRINT'fieldname$(1)" (";size(1);")
chars.";no
 4040  field$(1)=STR$(no)+STRING$(size(1)
-LEN(STR$(no))," ")
 4050  FORfield= 2 TO fields
 4060    PRINT'fieldname$(field)"
(";size(field);") chars.";
 4070    INPUTfield$(field)
 4080    field$(field) = field$(field)+
STRING$(size(field)-
LEN(field$(field)) ," ")
 4090   NEXTfield
 4100 UNTIL FNok("Any errors? Y/N")="N"
 4110 ENDPROC

 4120 DEF PROCwriterecord(no,reclength)
 4130 LOCALfield
 4140 PTR#file=no*reclength
 4150 FORfield= 1 TO fields
 4160   PRINT#file,field$(field)
 4170 NEXTfield
 4180 ENDPROC

11000 DEF FNok(X$)
11010 LOCAL an$
11020 PRINT'X$
11030 *FX21,0
11040 REPEAT an$=GET$:UNTILan$="Y" OR an$="N"
11050 =an$
```

particular routine will vary with the application. Our present stockfile needs printing in a number of ways, and so is coded as required. To alter the file printing program for any other application, only this key routine needs to be changed.

Program 7 shows the main body of an RAF printing program. It is identical to the others which we have created up to line 160, except mode three is used for a better screen display of columns. Next, we use a 'choice' routine to allow the operator to select which fields are to be printed (program 8).

This routine returns a number which relates to the set of fields required for printing out according to figure 3. As the computer reads through the data file, many records will initially be empty. It is not worth printing these blank records, and so we need to test every record to see if it is empty. This is done by the procedure DEF PROCprint(option), shown as program 9. As can be seen, the first field of each record is INPUT#ed in the computer, then the file pointer is reset to the beginning of the record, by line 4040. Next it is checked for a valid product code, ie, not just spaces. This is done at line 4050 and valid records are passed to the DEF PROCprint

Choice	Fields printed
1	1,2,3,4,5,6,7,8,9
2	1,2,3,4
3	1,2,5,6,7,8
4	1,2,5,9
0	EXIT

Figure 3. Field selection table

record(option) routine for actual printing. If the record is empty, the file pointer is incremented to the next record, by the commands following ELSE in the same line 4050.

The routine to print records (progam 10) includes the most frequently-used utilities previously examined, and is easily coded for any particular application. We simply read each field of the record into memory, then decide which fields to print using the rules of figure 3. The decision to print a field comes as a result of an IF statement, and these are grouped to allow the sets of fields needed for each option to be printed. Because every field is followed by a semicolon, we must force a new line at the end by including the PRINT command of line 5110.

Nowhere do we use the TAB function, as the fields are already padded with spaces. These extra spaces are useful because they automatically create columns. If we regularly fill the complete field widths with characters, we will need to add an extra space after each field, so line 5060 might become:

PRINTfield$(1);" ";field$(2);" ";

The smallest useful alteration to an RAF is

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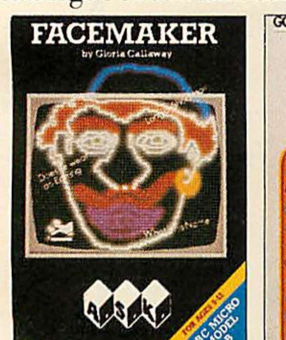
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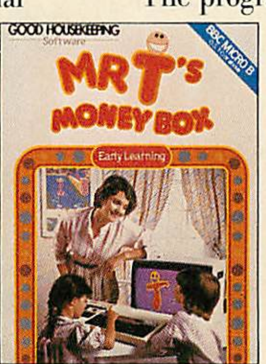
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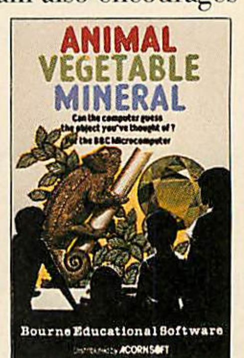
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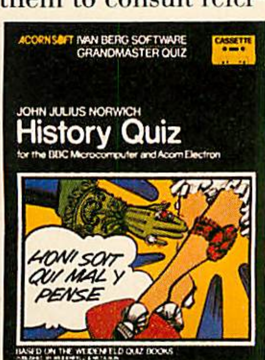
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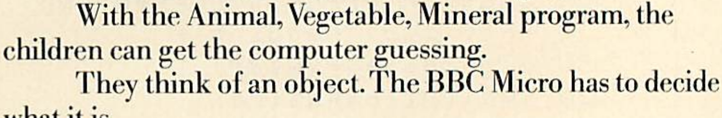
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Program 7. Demonstration printout program

```
100 ONERROR REPORT:CLOSE#0:END
110 MODE3
120 PROCload("heading")
130 DIMfield$(fields)
140 reclength=FNsize
150 name$="D.stock"
160 file=OPENUP(name$)
170 choice%=FNchoice
180 IF choice%=0 CLOSE#file:PRINT"Exit":END
190 IF PTR#file+reclength(=EXT#file PROCprint(choice%)
200 CLOSE#file
210 END
```

Program 8. Choice routine

```
3000 DEF FNchoice
3010 LOCALchoice
3020 REPEAT:CLS:PRINT"file: "name$
3030  PRINT''"Printout all,stock,address,phone,(1,2,3,4 - 0 to exit)"
3040  INPUT" Which? "choice
3050 UNTIL choice)-1 AND choice(5
3060 =choice
```

Program 9. Selects records for printing

```
4000 DEF PROCprint(option)
4010 LOCALA$,count
4015 count=0
4020 REPEAT
4030  INPUT#file,A$
4040  PTR#file=PTR#file-(size(1)+2)
4050  IFA$)STRING$(size(1)) PROCprintrecord(option) :count=count+1
:ELSE PTR#file=PTR#file+reclength
4060 UNTILPTR#file)=EXT#file
4070 PRINTcount;"RECORDS"
4080 ENDPROC
```

Program 10. Print record procedure

```
2000 DEFPROCload(name$):REM as is fig6

3100 DEF FNsize:REM as in fig7

5000 DEF PROCprintrecord(option)
5010 LOCAL field
5030 FOR field=1 TO fields
5040  INPUT#file,field$(field)
5050 NEXT
5060 PRINTfield$(1);field$(2);
5070 IFoption=1 OR option =2 PRINTfield$(3);field$(4);
5080 IFoption=1 OR option )2 PRINTfield$(5);
5090 IFoption=1 OR option =3 PRINTfield$(6);field$(7);field$(8);
5100 IFoption=1 OR option =4 PRINTfield$(9);
5110 PRINT:ENDPROC
```

changing the contents of one field of one record. The problem this poses is relatively simple, and can be solved by a simple algorithm:

- load the heading file;
- work out the record length;
- open the RAF;
- choose the field to change;
- choose the record containing that field;
- move the file pointer to that field;
- show what is in the field;
- enter new data;
- pad it with spaces;
- replace it in the RAF.

We can already perform many of the tasks required for this. Choosing field and record numbers is simply a matter of keyboard entry, to produce two numbers. Let's call them 'record' and 'field'. We now need to move straight to the field indicated and INPUT# it. Look at program 11. The file pointer is moved to the start of the correct record in line 5020, then, if necessary, it is incremented field by field to the start of the one required. This is done in line 5030. The contents of the field are read from disc, then the file pointer is set back to the beginning of the field ready for the writing operation. The function returns the field contents into the variable contents, as shown in line 200. We could, however, use a direct command, for example:

PRINT FNgetfield(7,3)

to show the contents of field three of record seven. This could help with debugging.

Changing the field contents is a task which can be performed now we have set the file pointer. We simply display the contents of the field nominated, take keyboard entry of the new contents, pad this entry, then PRINT# it to disc. Program 12 demonstrates the coding.

There will, sooner or later, be a need to search through an RAF and produce a printout, or even a subfile of the master file, by checking a particular field for certain information. Program 13 demonstrates the coding which solves a particular question that might arise: 'Have we a list of all the companies which sell printers?'

If the list of all the companies is in an RAF, we simply read each record in turn, placing the contents of each in a list. Then we can examine the chosen field for the information. In the example above, we should need to examine a particular field for the contents 'PRINTER'. The result is that we can print only those records that meet our needs. It is worth noting that we can be as precise or imprecise as we desire, because the routine will accept part of a word and search each field for a word containing that part, so that if we enter 'PRINT' as the search key, all the records containing 'PRINT', 'PRINTER', 'PRINTERS' will be displayed. ●

Next month we sort our file and look at a tray of chips.

Program 11. Returns contents of any field

```
 200   content$=FNgetfield(record,field,
       reclength)

 5000 DEF FNgetfield(record,hitfield,
      reclength)
 5010 LOCAL A$,field
 5020 PTR#file=record*reclength
 5030 IF hitfield>1 FOR field=1 TO
      hitfield-1
:PTR#file=PTR#file+size(field)+2:NEXT
 5040 INPUT#file,A$
 5050 PTR#file=PTR#file-(size(hitfield)+2)
 5060 =A$
```

Program 12. Changes contents of any field

```
 210   PROCchangefield(content$,record,field)

6000 DEF PROCchangefield(old$,record,
     hitfield)
6010 LOCAL new$
6020 REPEAT:PRINTTAB(0,20);"Record "
     ;record;" "fieldname$(hitfield)"
      is " old$
6030  PRINTTAB(0,22);"New contents
     (";size(hitfield);" chars) >> ";
6040  INPUT new$
6050 UNTIL LENnew$<size(hitfield)
6060 PRINT#file,new$+STRING$
     (size(hitfield)-LEN(new$)," ")
6070 PTR#file=0
6080 ENDPROC
```

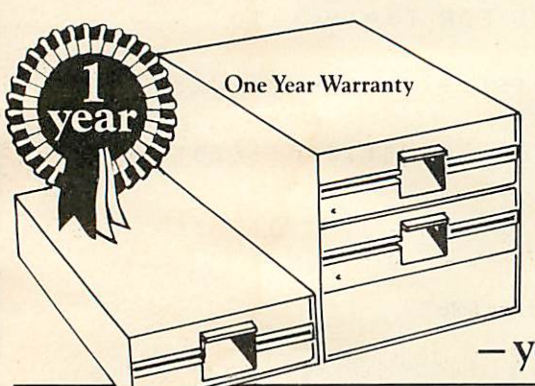
Program 13. Searches a RAF based on a keyword

```
  140 REPEAT
  150   PROCsearch(field,key$)
  160 UNTIL PTR#file>=EXT#file

 5000 DEF PROCsearch(field,key$)
 5010 LOCAL field
 5030 FOR field=1 TO fields
 5040   INPUT#file,field$(field)
 5050 NEXT
 5060 IFINSTR(field$(option),key$)>0
      FORfield= 1 TO
fields:PRINTfield$(field);:NEXT:PRINT
 5070 ENDPROC
```

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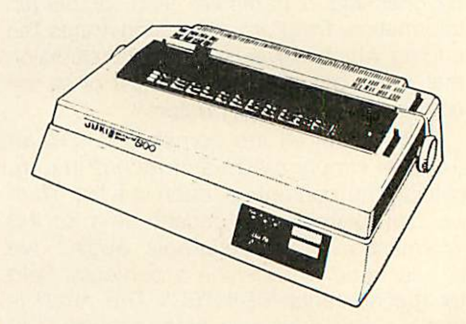
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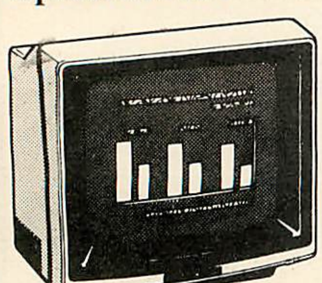
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PROTECTION RACKET

Mike Cooke pokes around in the Beeb's cassette filing system and discovers techniques of unlocking and locking files

THE *Advanced User Guide* provides many interesting pieces of information concerning various intricacies of the BBC. Chapter 11, for example, deals with previously uncharted regions of the memory map and it includes a description of some workspace used by the cassette filing system on page 3.

The locations &3B2 to &3D0 are used to store data recorded in the header blocks when programs are *SAVEd or *LOADed. This information allows you quickly to find your whereabouts on a tape, an advantage over the cassette filing systems employed on other micros.

A breakdown of the locations given above shows the memory allocation:

&3B2-&3BD	Filename terminated by zero
&3BE-&3C1	Load address of file
&3C2-&3C5	Execution address of file
&3C6-&3C7	Block number
&3C8-&3C9	Length of block
&3CA	Block flag byte
&3CB-&3CE	Spare
&3CF-&3D0	Checkdigits

It can be seen why 10 characters are allowed for the filename (&3B2-&3BD). Any bytes following the zero are ignored. The load address consists of four bytes – only the two least significant bytes are normally used; the other two are either 00 or &FF, depending on how the file was, or is, being saved. Similarly for the execution address.

The high byte of the block number is zero for machines whose memory has not been expanded by, for example, using twin processors. The length of the block has high byte 1 and low byte 0 unless the block is the last of a file, in which case the low byte could be as small as 1 and the high byte 0. The spare bytes are usually 0 and the checkdigits are derived using a Cyclic Redundancy Check, an algorithm for which appears in the guide.

And now the block flag byte: bit 0 is described as a 'protection bit – the file can only be *RUN if this bit is set'. Most interesting, but no further mention is made of it.

By peeking &3CA after escaping from a *SAVE operation it can be found that it contains 0 unless reading or writing the last block of a file, in which case it contains &80. In fact, all file operations reveal that bit 0 of &3CA is clear. How then does this 'protection' work?

It might be thought that ?&3CA=1 before *SAVEing would work, but &3CA is overwritten with 0 as soon as RETURN is pressed to start the *SAVE. Clearly a more involved approach is required.

Examining some widely available games programs, it was found that some parts of the program would not *LOAD, producing the message 'Locked'. They would respond to *RUN, though, apparently loading quite normally (they crashed soon after as they were not complete programs in themselves). Clearly this protection bit needed investigating.

Now if a locked file is *LOADed the front header block is transferred to locations &3B2 to &3D0 before the load is aborted and, sure enough, &3CA contains 1. Presumably after the header block is picked up a part of the operating system checks bit 0 to decide whether to *LOAD or not. It occurred to me that if bit 0 were cleared in between picking up the front header block and checking the contents of &3CA then the locked file could be forced to load.

The time available to achieve this was probably quite small and, worse still, how could you tell when to clear bit 0? The answer seemed to be to continually clear bit 0 using an interrupt. The interrupt routine had to be serviced many times per second if it stood a chance of catching the bit 0 before the abort.

One of the easiest ways of using interrupts is to allow event handling with the *FX14 command. One of these events is the start of vertical synchronisation, which is normally used to wait until an appropriate time to write to the 6845 so that any flickering on the screen is minimised. This event occurs every 1/50 second (1/60 second in USA). By intercepting the event handling routine and redirecting it to a routine at &D00 it was possible to clear bit 0 of &3CA every 1/50 second and this proved sufficiently often to force the locked program to *LOAD with no problems (see program 1).

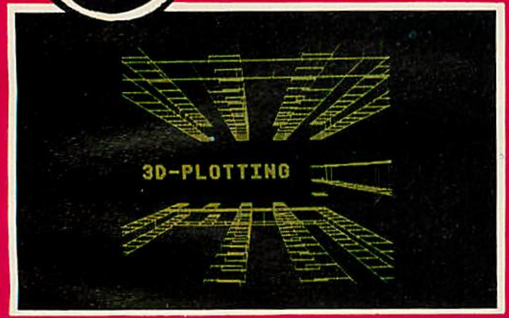
Type the program in and RUN it and it will *LOAD any locked file until BREAK is pressed. This has the effect of disabling the event and resetting the event vector. Notice that the status, X, Y and A registers are saved on the stack so that any further processing will not wipe out their values, as these must be restored before returning from the routine. Line 100 loads the block flag byte into the

```
 10 FOR I%=0 TO
    2 STEP 2
 20 P%=&D00
 30 [OPTI%
 40 PHP
 50 PHA
 60 TXA
 70 PHA
 80 TYA
 90 PHA
100 LDA&3CA
110 AND#&FE
120 STA&3CA
130 PLA
140 TAY
150 PLA
160 TAX
170 PLA
180 PLP
190 RTS
200 ]NEXT
210 ?&220=0
220 ?&221=&D
230 *FX14,4
```

Program 1. *LOADS a locked program

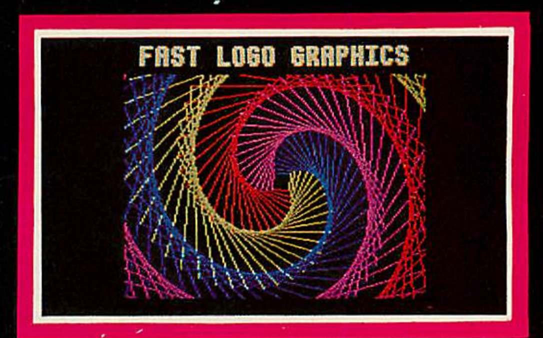
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accumulator where bit 0 is masked out in line 110 and then the byte returned to &3CA. Lines 210 and 220 make the event vector point to the routine which is assembled at &D00. Line 230 enables the start of vertical synchronisation event.

It seemed a straightforward step to produce locked files of my own. By adding the lines:

```
113 CLC
116 ADC#1
```

it is possible to lock both machine code and Basic programs. Clearly, if someone knows how to unlock your program then you are sunk unless you incorporate some other security precautions. Some ideas used in commercial software are now described.

Using *OPT1 2 before loading a program results in some extra information being displayed on the screen after the loading is complete, namely the 'load' address and the 'execution' address. These are taken from locations &3BE-&3C5 at the end of the load. It is the values in the *front* header block that determine the actual load address and this need not be the same as the values in the last header block, which are displayed with *OPT1 2.

Using some other event (the 'character entering input buffer' is useful) it is possible to change the value in &3BE and &3BF before the last block is saved. This can be quite misleading as the unsuspecting user tries to find a program that does not start where he thinks it does. Also, the execution address may be altered on the last block, sending people off disassembling code which does nothing useful at all.

Further possibilities open up when trying to 'hide' a Basic program using methods like the above. At some stage in the proceedings it may be necessary to reset PAGE, for example. This can be done in machine code by redirecting the read character vector (RDCHV) to take the input from a section of memory as if it had been typed directly from the keyboard. It is helpful to turn the VDU drivers off with the equivalent of VDU2 1 before doing this, otherwise a brief flash of letters on the screen may give the game away.

A machine code program may be *RUN from inside another machine code program by using a JMP(&21E) with A=4, and X and Y pointing to the address of the filename (terminated with &D). Also, the break key can be intercepted by arranging to have a JMP (direct) instruction at locations &287 to &289. The break key can also cause the memory to be cleared with *FX200 2.

As most of the above applies only to OS 1.0 onwards a check may need to be made on the machine in use before trying to use calls that do not exist on 0.1's. This can be achieved easily by the instructions LDA#&81:LDX#0: LDY#&FF:JSR&FFF4. This call usually tests for key closures when X is nonzero, but here it decides which operating system is present. On RETURN, X is 0 on a 0.1 and &FF on a 1.0 or above. The ideas presented here should help those trying to make their software more secure as well as those with less scrupulous intentions. It is impossible to make a program totally secure but it is interesting to try and also see what other people have tried.

CIRCULAR ARGUMENT

Samar Singh of the Department of Nautical Studies, Hong Kong Polytechnic, presents two quick-on-the-draw programs

THESE two small programs can draw a circle of any radius in less than half a second. Program 1 draws a full outline of the circumference with a resolution of 10 degrees, while program 2 draws a dotted circle with a resolution of five degrees.

Both listings incorporate a small demonstration program, followed by the procedures that draw the circle. Before calling the procedure a graphics mode must be chosen, and in program 1 X% and Y% arrays must be dimensioned.

In both programs three arguments have to be passed to the procedures. Cx and Cy indicate the co-ordinates of the centre of the circle, where the graphics origin remains, while R% denotes the radius.

Picturesque results may be obtained by using random values for a GCOL command and also for the arguments as well as the K value in Plot K,x,y.

```
 960 S=TIME
 970 DIM X%(9):DIM Y%(9):MODE 1:PROCCIRC(640,512,4
00)
 980 PRINTTIME-S
 990 END
1000 DEFPROCCIRC(Cx,Cy,R%)
1010 VDU29,Cx;Cy;
1020 X%(0)=0:Y%(0)=R%:MOVE0,R%
1030 FORN%=1 TO 9:X%(N%)=X%(N%-1)*.9848+Y%(N%-1)*.
1736:Y%(N%)=Y%(N%-1)*.9848-X%(N%-1)*.1736:NEXT
1040 FORN%=0 TO 9:PLOT5,X%(N%),Y%(N%):NEXT
1050 FORN%=9 TO 0 STEP-1:PLOT5,X%(N%),-Y%(N%):NEXT
1060 FORN%=0 TO 9:PLOT5,-X%(N%),-Y%(N%):NEXT
1070 FORN%=9 TO 0 STEP-1:PLOT5,-X%(N%),Y%(N%):NEXT

1080 ENDPROC
```

```
 300 S=TIME
 400 MODE 1:PROCCIRC(640,512,400)
 420 PRINTTIME-S
 440 END
 500 DEFPROCCIRC(Cx,Cy,R%)
 510 VDU 29,Cx;Cy;:X%=0:Y%=R%
 520 FORN%=1 TO 10:PROCC(X%,Y%):NEXT
 530 ENDPROC
 540 DEFPROCC(A%,B%)
 550 VDU25,69,X%;Y%;25,69,Y%;X%;25,69,-X%;-Y%;25,69,-Y%;
-X%;25,69,-Y%;X%;25,69,X%;-Y%;25,69,Y%;-X%;25,69,-X%;Y%;
 560 Y%=INT(B%*.9962-A%*.0872):X%=INT(A%*.9962+B%*.0872)
 570 ENDPROC
```

COLOUR VALUE

The MCP40 printer/plotter is a versatile tool for educational or scientific use – or just for fun. George Hill guides you around its idiosyncrasies

FIRST, let me say the MCP40 is fun. I have spent a most enjoyable time producing all sorts of beautiful pictures. It is a fantastic mini-graph-plotter, at a remarkable price.

The mechanism and commands are identical to those of the Tandy CGP115, and the Oric printer. The Tandy version has been reviewed already with the Atom (August 1983). The MCP version (loaned by the importers, Micro Peripherals) has two advantages. One is price: it retails for under £130. The second is the built-in power supply.

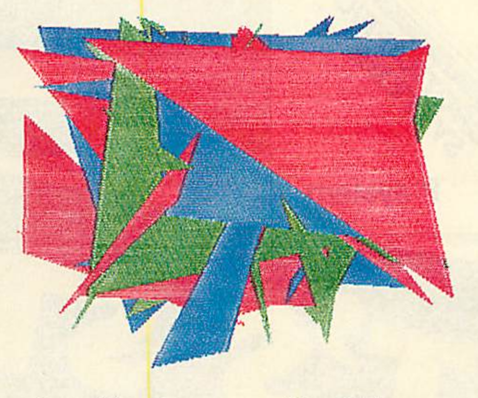
Four coloured ball-point pens are used (unfortunately special sizes, so ordinary refills cannot be used). These are installed in a small holder, which rotates the required pen to the top when the command 'Cn' is issued (n is the pen number, 0 to 3). Each pen is operated by a small solenoid which brings it into contact with the paper.

The paper comes as a roll 4.5 inches (11.5cm) wide, in a built-in holder. It is fed by an amazingly accurate mechanism which seems to rely on a toothed wheel, and friction combined. The paper will feed in either direction by any amount, though reverse feeds of several feet are to be avoided as there is no take-up mechanism on the roll. Lines can be drawn at any position on the paper.

Firmware (programs in ROM or EPROM) enables the MCP40 to be used as a printer, by 'drawing' letters. This seems impossibly fast, but is actually a slow 12 characters per second. The printing is in 40 character or 80 character lines, selected by an incorrectly labelled DIP switch on the bottom of the printer. However, 80 characters on a four-inch line is beyond my eyesight! (figure 1).

The MCP40 and its brethren are essentially graph plotters, and as such are brilliant at drawing lines. They most definitely are not high-speed printers. I have not used one to produce a single listing, as it is quicker to disconnect and switch to a dot-matrix printer than to wait while the MCP40 chugs away at 12 cps. They are also not at their best with screen dumps, though small, beautiful pictures result.

The plotter draws in four colours: black, red, green and blue. These do not match the colours in modes 1 and 5, and yield curious results if a direct pen-number/colour-value dump is carried out. I also found my pen-holder was not marked as in the manual. To avoid the continuous bother of colour-matching I used the pens in the following order: position 0 black; position 1



red; position 2 green; position 3 blue.

Once switched on, the printer is in text mode. It then performs a seemingly interminable (described in the manual as 'short') test routine, drawing four squares. This prevents the use of the on/off switch for resetting the printer, as the squares are printed over any text or drawing unless you are careful. I found no satisfactory single command which would reset completely without drawing the test squares. Conversion to plotter mode is by CHR$18, and back to text by CHR$17. There is a limited number of control characters for text mode, but clearly the MCP40 is not designed for word processing. Underline, backspace and reverse linefeed are all available. You need to go into graphics mode briefly to change text colour or character size. I found a strange quirk in the colour changing command. If you want to change colour on a single line it is necessary to send a backspace before switching to graphics and changing pens. Very odd! Programs 1 and 1a show how to use the text mode commands. Program 1 will work with all versions of the operating system, 1a uses *FX3 which is only implemented from OS1.0 on.

The graphics mode is the strength of this kind of printer. All the commands (except the switching in and out of graphics) are sent as strings of characters, followed by carriage return (ASCII 13). There are several ways of doing this. You could employ VDU21 to disable the screen while the string was prepared and sent, or use *FX3,10 as in program 1a. There are difficulties in both these methods. If you have OS1.0, and possibly earlier versions, the VDU21 method will not work (October 1983, page 101). This is due to the unfortunate fact that carriage returns (CHR$13) are filtered out. *FX3 is restricted as stated above. The alternative is to use VDU1. I stuck to the VDU1,n method, hence its use in PROCdraw(D$) in the subsequent programs. This procedure sends the string D$ and a carriage return to the printer.

In addition to normal line drawing facilities, there is the ability to draw dotted lines of 63 different kinds, print text at any position, and in any direction – very useful for labelling graphs or charts, and to print *x* and *y* axes, complete with scale graduations. The last ability certainly impressed my scientific colleagues. Program 2 illustrates some of these points.

Programs 3 and 4 are screen dumps. The major limitation to the speed of the plotter is the time taken to change pens. A dump which read the pixels along a line and switched pens at each colour change was interminable. The fastest effort took best part of an hour to print the testcard! I doubt whether there is any way of speeding this up. I therefore switched to the 'three-scan' method. The screen is first checked line-by-line for red (colour 1). The points are not printed individually as dots. The line is scanned detecting changes in colour. The printer draws a line when a change from the current scanned colour is detected, and moves the pen, without drawing, when a change from the background colour is detected. The string to be sent to the printer is prepared in PROCstring, which decides on draw (D) or move (M), and calculates the necessary coordinates. It is then sent to the printer by PROCdraw(D$). At the end of the 'red' scan, the printer is reset to the top of the picture, and the screen scanned for colour 2, printed as green, and then for colour 3 printed as blue.

Early efforts used the scanning techniques developed in my articles over the last months, ie, FOR Y%=1023 TO 0:FOR X%=0 TO 1279 etc. This was still slow, and failed to use the printer's ability to draw lines in either direction. I evolved a 'swinging' technique in program 4. The Y%

loop is conventional, but the X% loop runs from 'one_end' to 'other_end' by STEPs of 'step'. At the end of each line (whichever end) the variable 'flag' is changed from −1 to 0 or vice-versa by the line:

flag=flag EOR −1

This is difficult to explain for floating point variables, but is illustrated in figure 2 for a single byte. −1 is the number with all the bits set, ie, 1111111111 etc in binary. The EOR function gives 1 if one bit is 0 and the other is 1, but gives 0 if both are 0 or both are 1. Thus −1 EOR −1 gives 0 (all bits are 1s), and 0 EOR −1 gives −1 (all pairs of bits are 1 and 0, giving a result of all 1s).

Values of 'one_end', 'other_end' and 'step' are switched according to the value of 'flag'.

Basic was still slow, so I enlivened the proceedings with a shot of assembler for program 5. This is about as fast as the printer can go using this technique. Further gains might be made by avoiding pen movement altogether on blank lines, but the extra coding did not seem worth the effort.

This program works on an entirely different basis from my previous dumps for dot-matrix printers. The slowness here is in the scanning of the blank and unchanged dots. Basic seems fast enough to prepare the strings, and assembler string handling is pretty horrific to write, so preparation of 'printer bytes' is done in Basic, and the line scanning inside the assembled code. The assembly routine is complex, and turgidly structured I fear! The routine hits an rts instruction (returning to line 120) under three conditions. First, if a colour change is detected; second if during a l_to_r scan X% becomes >1276, and third if during a r_to_l scan X% becomes =0. On each return the appropriate string is prepared and sent, and if the end_of_line flag is also set, the appropriate changes are made in PROCadjust.

The second set of programs results from a desire to avoid learning yet another graphics scheme when wishing to produce pictures. Every computer and every printer has its own idiosyncratic scheme of *x* and *y* scaling. MCPDRAW allows you to use the MCP40 as a drawing instrument while still using BBC Basic graphics screen coordinates, and commands (or almost!).

The screen is set to mimic the printer, so the background colour is white, colour 1 is red (note the pen must be correctly positioned), colour 2 is green, and colour 3 is blue. You can draw lines in colour 0 on the plotter, but these will not appear on the screen. (If anyone has a simple method of getting a fourth screen colour in mode 1 please write in!) The system uses PROCMOVE(X,Y) and PROCDRAW(X,Y) in place of the normal MOVE and DRAW, PROCCOL(c) in place of GCOL0,c, and PROCMREL and PROCDREL in place of the relative moving and plotting commands. The latter two caused great heartache, and the results are not guaranteed for all programs. Any slight rounding errors in relative plotting tend to become compounded as the plotting progresses, and minor errors can lead to major displacements.

Program 5 uses 'overlays' (November 1983, page 67). The method is substantially the same as Patrick Quick's, though my merging technique uses OSFILE and checks that the file exists before attempting to merge. This avoids the fatal error messages if there is no file found and the disc filing system is in operation. The prefix 'D' is added to the filename if you do not specify a directory. Lines 1 to 4 are a 'clever' technique to store the value of TOP-2 for merging. T% is set to the value of TOP-2 for the program remaining *after* the first four lines have been *removed. This* means that while de-bugging, the program may be re-run after a crash without deleting the drawing program, or finding more than one *drawing program* appended.

It is essential that these four lines are typed *exactly* as they appear without any extra or omitted spaces, or spaces at the ends of the lines, otherwise the calculation of TOP-2 will be incorrect.

The overlays may be merged on from

```
This is a test routine
THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG
the quick brown fox jumps over the lazy dog in red
Now to underline green text in blue.

This is a test routine
THE QUICK BROWN FOX JUMPS OVER THE LAZY
DOG
the quick brown fox jumps over the lazy
dog in red
Now to underline green text in blue.

This is a test routine
THE QUICK BROWN FOX JUMPS
OVER THE LAZY DOG
the quick brown fox jumps
over the lazy dog in red
Now to underline green tex
t in blue.
```

Figure 1. Example text

For Individual Bits

1 EOR 1 = 0
1 EOR 0 = 1
0 EOR 1 = 1
0 EOR 0 = 0

For a Byte

1111 1111 EOR 1111 1111 = 0000 0000 = 0
and 0000 0000 EOR 1111 1111 = 1111 1111 = −1

Figure 2. Use of EOR to switch from 0 to −1 and back

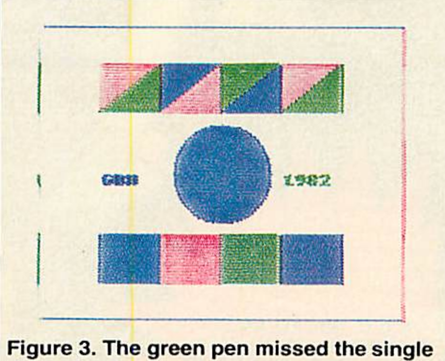


Figure 3. The green pen missed the single dots when not 'warmed up'

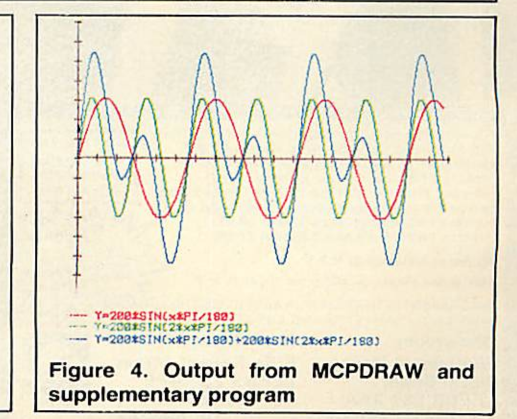


Figure 4. Output from MCPDRAW and supplementary program



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disc or tape (delete lines 23 and 117). The overlays are called by the line GOSUB 750, and so must be numbered from 750, and finish with a return. They carry out the drawing of the required pictures. No great search for speed has been made, as I felt ease of use and adaptation were more important.

The manual with the MCP40 is a tatty affair, which contains several bad misprints (correction sheets supplied). The programs are in LPRINT terms, but the explanations are reasonably clear. The commands are pretty self-explanatory anyway.

A final verdict then. The MCP40 can be a great educational tool with the correct programming. It has a wide variety of possible uses in business for producing readable statistics, but would require skilled programming. For the home user, it is super fun at a reasonable price, though limited by paper width and slow printing speed.

The price of the MCP40 is £113 + VAT. Rolls of paper cost £3 + VAT and a set of eight new pens is £5 + VAT.

Program 1. Using text mode commands, any OS (a) uses *FX3, series one OS only

```
   10 REM PROGRAM 1
   20 REM MCP40 TEST ROUTINE
   30 VDU2
   40 FOR size=0 TO 2
   50 VDU1,18,1,ASC"S",1,48+size,1,13,1,
ASC"C",1,ASC"0",1,13,1,17
   60 PRINT"This is a test routine"
   70 PRINT"THE QUICK BROWN FOX JUMPS OV
ER THE LAZY DOG"
   80 VDU1,18,1,ASC"C",1,ASC"1",1,13,1,1
7
   90 PRINT"the quick brown fox jumps ov
er the lazy dog in red"
  100 VDU1.18,1,ASC"C",1,ASC"2",1,13,1,1
7
  110 PRINT"Now to underline";
  120 VDU1,8,1,8,1,8,1,8,1,8,1,8,1,8,1,8
,1,8,1,18,1,ASC"C",1,ASC"3",1,13,1,17
  130 PRINT"__________";
  140 VDU1,8,1,18,1,ASC"C",1,ASC"2",1,13
,1,17
  150 PRINT"  green text in blue."''
  160 NEXT
  170 VDU3
```

```
   10 REM PROGRAM 1a
   20 REM MCP40 TEST ROUTINE
   30 *FX3.10
   40 FOR size=0 TO 2
   50 PRINTCHR$18;"S";STR$size;CHR$13;"C
0"
   60 PRINTCHR$17;
   70 PRINT"This is a test routine"
   80 PRINT"THE QUICK BROWN FOX JUMPS OV
ER THE LAZY DOG"
   90 PRINTCHR$18;"C1"
  100 PRINTCHR$17;
  110 PRINT"the quick brown fox jumps ov
er the lazy dog in red"
  120 PRINTCHR$18;"C2"
  130 PRINTCHR$17;
  140 PRINT"Now to underline";
  150 FOR I=1 TO 9:PRINTCHR$8;:NEXT
  160 PRINTCHR$18;"C3"
  170 PRINTCHR$17;
  180 PRINT"__________";
  190 PRINTCHR$8;CHR$18;"C2"
  200 PRINTCHR$17;
  210 PRINT"  green text in blue."''
  220 NEXT
  230 *FX3,0
```

Program 2. Using graphics

```
   10 REM PROGRAM 2
   20 REM EXAMPLE DRAWING PROGRAM
   30 DIM command 50
   40 REM switch to graphics
   50 PROCdraw(CHR$18)
   60 REM position pen, draw lines
   70 FOR I=1 TO 12
   80 READ A$
   90 PROCdraw(A$)
  100 NEXT
  110 DATA "M50,-300","I","C0","D100,0",
"C1","D100,100","C2","D0,100","C3","D0,0
","C0","M20,75"
  120 REM print rotated text
  130 FOR I=0 TO 3
  140 READ A$
  150 PROCdraw("Q"+STR$I)
  160 PROCdraw("P"+A$)
  170 NEXT
  180 DATA "NORTH","EAST","SOUTH","WEST"
  190 REM reposition cursor and return t
o text
  200 PROCdraw("M0,-100")
  210 PROCdraw("A")
  220 END
  230
  240 DEFPROCdraw(D$)
  250 LOCAL I
  260 D$=D$+CHR$13
  270 $command=D$
  280 VDU2
  290 FOR I=0 TO LEN(D$)
  300 VDU1,command?I
  310 NEXT
  320 VDU3
  330 ENDPROC
```

Program 3. 'Three-scan' method screen dump

```
 1000 REM MCP40 DUMP three scan version
 1010 REM VERSION 4
 1020 REM G.B.Hill (c) July 1983
 1030 PROCdump
 1040 END
 1050
 1060 REM***main procedure***
 1070
 1080 DEFPROCdump
 1090 DIM command 20
 1100 set_up$=CHR$17+CHR$18+"M60,-300"+C
HR$13+"I"
 1110 VDU2
 1120 REM set printer into graphics, and
 set origin
 1130 PROCdraw(set_up$)
 1140 FOR C=1 TO 3
 1150 REM set pen colour
 1160 PROCdraw("C"+STR$(C))
 1170 colour_store=0
 1180 left_end=TRUE
 1190
 1200 REM * main scanning loop *
 1210 FOR Y%=1020 TO 0 STEP -4
 1220 IF left_end THEN one_end=0:other_e
nd=1276:step=4 ELSE one_end=1276:other_e
nd=0:step=-4
 1230 FOR X%=one_end TO other_end STEP s
tep
 1240 colour=POINT(X%,Y%)
 1250 IF colour<>C THEN colour=0
 1260 IF colour<>colour_store THEN PROCs
tring
 1270 NEXT
 1280 PROCstring
 1290 REM switch scan direction
 1300 left_end=left_end EOR -1
 1310 NEXT
 1320 NEXT
 1330
 1340 REM re-positon cursor and return t
o text mode
 1350 PROCdraw("M0,-300").
 1360 VDU1,65,3
 1370 ENDPROC
 1380
 1390 REM ***sub-procedures***
 1400
 1410 DEFPROCstring
 1420 IF colour_store=0 THEN command$="M
" ELSE command$="D"
 1430 command$=command$+STR$(X% DIV 4)+"
,"+STR$(Y% DIV 4)
 1440 PROCdraw(command$)
 1450 colour_store=colour
 1460 ENDPROC
 1470
 1480 DEFPROCdraw(D$)
 1490 D$=D$+CHR$13
 1500 $command=D$
 1510 FOR I=0 TO LEN(D$)
 1520 VDU1,command?I
 1530 NEXT
 1540 ENDPROC
```

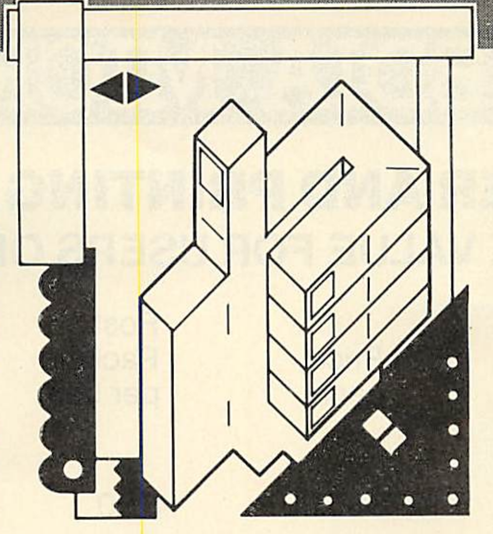
```
 1000 REM MCP40 DUMP three scan hybrid v
ersion
 1010 REM VERSION 5
 1020 REM G.B.Hill (c) July 1983
 1030 PROCdump
 1040 END
 1050
 1060 REM***main procedure***
 1070
 1080 DEFPROCdump
 1090 REM assemble code
 1100 PROCassemble
 1110 REM set up variables, and set prin
ter
 1120 DIM command 20
 1130 set_up$=CHR$17+CHR$18+"M60,-300"+C
HR$13+"I"
 1140 VDU2
 1150 PROCdraw(set_up$)
 1160
 1170 REM * Main scanning loop *
 1180
 1190 FOR C=1 TO 3
 1200 PROCdraw("C"+STR$(C))
 1210 X%=0:Y%=1024
 1220 !Xlo=X%+Y%*&10000
 1230 ?colour=0
 1240 ?current_colour=C
 1250 REPEAT
 1260 CALLstart
 1270 X%=!Xlo AND &FFFF
 1280 PROCstring
 1290 IF ?end_of_line THEN PROCadjust
 1300 UNTIL Y%<0
 1310 NEXT
 1320
 1330 REM rem clear paper, and reset tex
t mode
 1340 PROCdraw("M0,-200")
 1350 VDU1,17,3
 1360 ENDPROC
 1370
 1380 REM ***sub-procedures***
 1390
 1400 DEFPROCstring
 1410 IF ?colour_store=0 THEN command$="
M" ELSE command$="D"
 1420 command$=command$+STR$(X% DIV 4)+"
,"+STR$(Y% DIV 4)
 1430 PROCdraw(command$)
 1440 ENDPROC
 1450
 1460 DEFPROCdraw(D$)
 1470 D$=D$+CHR$13
 1480 $command=D$
 1490 FOR I=0 TO LEN(D$)
 1500 VDU1,command?I
 1510 NEXT
 1520 ENDPROC
 1530
 1540 DEFPROCadjust
 1550 Y%=Y%-4
 1560 ?Ylo=Y% MOD 256:?Yhi=Y% DIV 256
 1565 REM set X% back to 1280 from 1276
for reverse scan
 1570 IF ?flag THEN CALL inX
 1580 ?end_of_line=0
 1590 ENDPROC
 1600
 1610 DEFPROCassemble
 1620 DIM S% 180
 1630 Xlo=S%
 1640 Xhi=S%+1
 1650 Ylo=S%+2
 1660 Yhi=S%+3
 1670 colour=S%+4
 1680 current_colour=S%+5
 1690 colour_store=S%+6
 1700 end_of_line=S%+7
 1710 flag=S%+8
 1720 ?flag=0
 1730 S%=S%+9
 1740 FOR opt=0 TO 2 STEP 2
 1750 P%=S%
 1760 [OPT opt
```

```
1760 [OPT opt
1770 .point         lda #9
1780                ldx #Xlo MOD 256
1790                ldy #Xlo DIV 256
1800                jsr &FFF1            \osword
1810                rts
1815 \
1820 .inX           lda Xlo              \increment Xlo by 4 and Xhi if carry
1830                clc
1840                adc #4
1850                sta Xlo
1860                lda Xhi
1870                adc #0
1880                sta Xhi
1890                rts
1895 \
1900 .deX           lda Xlo              \decrement Xlo by 4 and Xhi if borrow
1910                sec
1920                sbc #4
1930                sta Xlo
1940                lda Xhi
1950                sbc #0
1960                sta Xhi
1970                rts
1975 \
1980 .eol           lda Xhi              \line end?
1990                cmp #5
2000                rts                  \zero flag set at end of line
2005 \
2010 .bol           lda Xlo              \line start?
2020                cmp #0
2030                beq bol2
2040                rts
2050 .bol2          lda Xhi
2060                cmp #0
2070                rts                  \zero flag set at line beginning
2080 \
2090 .sort_colour   jsr point
2100                lda colour
2130                cmp current_colour
2140                beq equal
2150 .zero_colour   lda #0               \colour=0 except if scanned colour
2160                sta colour
2170 .equal         rts
2180 \
2190 .l_to_r        jsr sort_colour
2200                lda colour
2210                cmp colour_store
2220                beq right_end
2230                rts                  \return if colour<>colour_store
2240 .right_end     jsr inX              \otherwise test for end of line
2250                jsr eol
2260                bne l_to_r           \keep reading until colour changes
2270                jsr deX              \reset X% back to 1276 from 1280
2280                jmp line_end
2285 \
2290 .r_to_l        jsr deX
2300                jsr sort_colour
2310                jsr bol              \check for line beginning, if not
2320                beq line_end
2330                lda colour
2340                cmp colour_store
2350                beq r_to_l           \keep reading until colour changes
2360                rts
2365 \
2370 .line_end      lda flag             \switch flag between &FF and 0
2380                eor #&FF
2390                sta flag
2400                lda #&FF             \and set end of line flag
2410                sta end_of_line
2420                rts
2425 \
2426 \*** control loop ***
2427 \
2430 .start         lda colour           \store last colour
2440                sta colour_store
2450                lda flag             \scan in required direction
2460                cmp #&FF
2470                beq go_left
2480 .go_right      jmp l_to_r
2490 .go_left       jmp r_to_l
2500 ]
2510 NEXT
2520 ENDPROC
```

Program 4. Assembler speeds up dump

```
1 T%=TOP-&43:S%=FALSE
2 *KEY1DELETE 1,4|MRUN|M
3 *FX138,0,129
4 END
5 REM MCP40 DRAWER
6 REM G.B.HILL OCTOBER 1983
7 REM USE PROCMOVE(X,Y), PROCDRAW(X,
Y) and PROCCOL(C) as MOVE,DRAW and GCOL0
alternatives.
8 REM PROCMREL(X,Y) and PROCDREL(X,Y
) are relative plot and draw routines.
9
10 REM Avoid overwriting variables -
increase offset if necessary.
11 LOMEM=T%+&500
12
13 REM Set up constants
14 osfile=&FFDD
15 DIM N% 9
16 DIM user 3
17 DIM control_block 17
18 DIM command 30
19
20 REM*** Merge on drawing file ***
21 PROCcheck_file
22 REM*** Omit the next line (23) if
using TAPE ***
23 IF ?user <>1 THEN TIME=0:PRINT'"Fi
le missing";CHR$7:REPEAT:UNTIL TIME>100:
GOTO 14
24 PROCmerge_file
25
26 REM*** Setting up screen and print
er ***
27 MODE1
28 VDU19,0,7;0;
29 VDU19,2,2;0;
30 VDU19,3,4;0;
31 REMVDU29,640;512;
32 REM set printer origin
33 PROCdraw(CHR$18)
34 PROCdraw("M80,-612")
35 PROCdraw("I")
36
37 REM Jump to drawing program.
38 GOSUB 750
39 PRINTTAB(0,31)"Any key to continue
":Z=GET
40 CLS
41 PRINTTAB(0,2)"You can 1) re-run th
is routine";TAB(8,3);"2) merge on anothe
r routine";TAB(5,4)"or 3) end";TAB(2,6);
"Type 1,2 or 3 ";
42 REPEAT:PRINTTAB(16,6)"            ":IN
PUTTAB(16,6)""n%:UNTIL n%>0 AND n%<4
43 IF n%=1 THEN 27
44 IF n%=2 THEN 21
45 END
46
47 REM*** Moving and drawing procedur
es ***
48
49 DEFPROCMOVE(X,Y)
50 MOVEX,Y
51 PROCPRINTER("M")
52 ENDPROC
53
54 DEFPROCDRAW(X,Y)
55 DRAWX,Y
56 PROCPRINTER("D")
57 ENDPROC
58
59 DEFPROCMREL(X,Y)
60 PLOT0,X,Y
61 PROCPRINTER("R")
62 ENDPROC
63
64 DEFPROCDREL(X,Y)
65 PLOT1,X,Y
66 PROCPRINTER("J")
67 ENDPROC
68
69 DEFPROCCOL(C)
70 GCOL0,C
71 C=C MOD 4
72 PROCdraw("C"+STR$(C))
73 ENDPROC
74
75 DEFPROCHOME
76 MOVE0,0
77 PROCdraw("H")
78 ENDPROC
79
80 DEFPROCRESET
81 PROCdraw("M0,-200")
82 PROCdraw("A")
83 ENDPROC
84
85 REM * send command string to print
er *
86 DEFPROCPRINTER(COM$)
87 IF X<0 THEN X=ABS(X):X=2*(X DIV 8)
:X=X*-1 ELSE X=X DIV 4
88 IF Y<0 THEN Y=ABS(Y):Y=2*(Y DIV 8)
:Y=Y*-1 ELSE Y=Y DIV 4
89 REMX=2*(X DIV 8):Y=2*(Y DIV 8)
90 PROCdraw(COM$+STR$(X)+","+STR$(Y))
91 ENDPROC
92
93 DEFPROCdraw(D$)
94 LOCAL I
95 VDU2
96 D$=D$+CHR$13
97 $command=D$
98 FOR I=0 TO LEN(D$)
99 VDU1,command?I
100 NEXT
101 VDU3
102 ENDPROC
103
104 DEFPROCcheck_file
105 CLS
106 INPUT'"Type in name of drawing pro
gram",filename$
107 IF MID$(filename$,2,1)<>"." THEN f
ilename$="D."+filename$
108 IF LEN(filename$)>9 THEN PRINT"Onl
y seven characters allowed":GOTO 106
109 $N%=filename$+CHR$&0D
110 FOR I=0 TO 8
111 IF N%?I>&40 THEN N%?I=N%?I AND &5F
112  NEXT
113 ?control_block=N% MOD &100
114 ?(control_block+1)=N% DIV &100
115 A%=5:X%=control_block MOD &100:Y%=
control_block DIV &100
116 REM*** Omit the next line (117)  i
f using TAPE ***
117 !user=USR osfile
118 ENDPROC
119
120 DEFPROCmerge_file
121 A%=&FF:X%=control_block MOD &100:Y
%=control_block DIV &100
122 !(control_block+2)=T%
123 ?(control_block+4)=&FF:?(control_b
lock+5)=&FF
124 ?(control_block+6)=0
125 CALLosfile
126 ENDPROC
```

Program 5. Drawing with BBC graphics co-ordinates. Lines 1 to 4 must be typed in with no more, or less, spaces



THIS problem page is a regular feature of *Acorn User* presented by Martin Phillips. It will present simple hints and tips and answer readers' queries about the Electron, BBC micro and BBC Basic. £5 will be paid for a 'star' letter, so you can profit from your problem!

If you have a query concerning some aspect of programming or some technical difficulty, please give sufficient information and make your question specific. The following query was received recently:

'I am in the middle of writing a program for an exam project on my 32k BBC. However, although the program is only just over 21k long, when it is run the computer prints up the error message "No room" or "Dim space". I would be grateful if you could tell me any methods of running the program successfully without the need to cut the program up.'

Now, there are any number of reasons why a program will run out of memory. Without knowing far more about the program, the style of programming and techniques used, and whether discs or Econet have been fitted, it is impossible to give anything but general hints on memory saving. It also helps to know the operating system and Basic.

So please bear these points in mind and include a listing if possible. Unfortunately, we cannot reply to letters individually, and are unable to return letters, listings, etc. Send your letters to: Hints & Tips, Acorn User, 53 Bedford Square, London WC1B 3DZ.

VDU CHAMBER OF HORRORS

ONE of the more complicated Basic statements on the BBC and Electron computers is the VDU statement. The VDU statement is used to control many of the screen functions and as such can have a variety of parameters following it.

One of the not-so-obvious problems is that the VDU statements are not error-trapped. That is to say, there is no check for the correct number or range of parameters. An odd fact is that missing or extra characters tend to be added or taken off the next VDU statement to be processed, causing that not to function as expected. This can create some weird problems – as we shall see.

I've received some tips from Ewan MacLeod, some of which I have included in the hints section, however, I had a wry chuckle at one of his tips, which I discovered and used when I first owned a BBC. On the surface it seems a good tip, but it has unexpected drawbacks that had me scratching my head for some time (I can laugh about it now!).

Ewan found it annoying not to be able to change mode inside a procedure. He suggests VDU22 could be used inside a procedure to change the mode. Indeed it can, and the *User Guide* seems to confirm this.

Listing 1 gives a short routine to draw a solid polygon, in this case a hexagon. The polygon can be changed by altering the parameter following the procedure name at line 40. The size of the polygon can be altered at line 90. The program goes into mode 4, and a blue background is set by line 30. This program should work correctly.

Now if Break is pressed, the Mode 4 statement changed to VDU22,4 and the program rerun (listing 2), a series of dots appears at the bottom right of the screen.

At first I thought this might be a bug in the 0.1 OS, but this effect appears just the same on 0.1 OS and 1.2 OS. It is caused by the fact that VDU22 does not change the value of HIMEM, so workspace has been allocated to the program that is now part of screen memory – hence the moving dots. This can be put right by entering line 25.

25 HIMEM=&5800

You must press Break after trying each program, otherwise HIMEM will not be reset.

That is not the worst that can happen. Press Break and alter the program as in listing 3, but take a recording of it before you run it. Now when it runs the program will crash with the dreaded 'Bad program' error, and garbage may appear on the screen.

The VDU22 statement needs using with care, and the value of HIMEM will need to be reset as appropriate. Changing this value is not advised during a program as it too can create its own set of faults, and it too must never be changed during a procedure. The best solution is never to attempt to change mode inside a procedure, at least until you are quite sure of what you are doing.

To end the chamber of VDU horrors: as mentioned earlier, no checks are made on the VDU statements and so even a missing comma can cause odd problems. Go back to listing 1 and ensure that it works correctly. Now add line 25 as shown in listing 4. This line will remove the flashing cursor as detailed on page 77 of the *BBC User Guide*. Now when the program is run the background colour remains black. The mistake here is a missing semi-colon at the end of line 25. It is missing in the *User Guide*, too. Notice that no error is reported. Inserting the semi-colon at the end of the statement will put matters right.

If you're wondering what the significance of the trailing semi-colon is, it indicates that the number it follows is a two-byte number. One byte is a number between 0 and 255.

Line 30 in listing 1 could be replaced by:

VDU19,0,4;0;

To change the program to draw an outline shape only, change line 150 to read:

150 PLOT 5,X,Y

The program will draw solid or outline circles by increasing the number of sides beyond 20.

```
   1 REM listing 1
  10 REM VDUproblems
  20 MODE 4
  30 VDU19,0,4,0,0,0
  40 PROCpolygon(6)
  50 END
  60
  70 DEFPROCpolygon(N)
  80 X=500:Y=0
  90 size=1800/N
 100 angle=2*PI/N
 110 FOR I=0 TO N-1
 120 MOVE500,0:MOVE X,Y
 130 X=X+size*COS(I*angle)
 140 Y=Y+size*SIN(I*angle)
 150 PLOT85,X,Y
 160 NEXT I
 170 ENDPROC
```

Listing 1.

```
   1 REM listing 2
  10 REM VDUproblems
  20 VDU22,4
  30 VDU19,0,4,0,0,0
  40 PROCpolygon(6)
  50 END
  60
  70 DEFPROCpolygon(N)
  80 X=500:Y=0
  90 size=1800/N
 100 angle=2*PI/N
 110 FOR I=0 TO N-1
 120 MOVE500,0:MOVE X,Y
 130 X=X+size*COS(I*angle)
 140 Y=Y+size*SIN(I*angle)
 150 PLOT85,X,Y
 160 NEXT I
 170 ENDPROC
```

Listing 2.

MICRO-MEDIA MICRO-MEDIA

```
  1 REM listing 3
 10 REM VDUproblems
 40 PROCpolygon(6)
 50 END
 60
 70 DEFPROCpolygon(N)
 75 VDU22,4,19,0,4,0,0,0
 80 X=500:Y=0
 90 size=1800/N
100 angle=2*PI/N
110 FOR I=0 TO N-1
120 MOVE500,0:MOVE X,Y
130 X=X+size*COS(I*angle)
140 Y=Y+size*SIN(I*angle)
150 PLOT85,X,Y
160 NEXT I
170 ENDPROC
```

Listing 3.

```
  1 REM listing 4
 10 REM VDUproblems
 20 MODE 4
 25 VDU23;8202;0;0;0
 30 VDU19,0,4,0,0,0
 40 PROCpolygon(6)
 50 END
 60
 70 DEFPROCpolygon(N)
 80 X=500:Y=0
 90 size=1800/N
100 angle=2*PI/N
110 FOR I=0 TO N-1
120 MOVE500,0:MOVE X,Y
130 X=X+size*COS(I*angle)
140 Y=Y+size*SIN(I*angle)
150 PLOT85,X,Y
160 NEXT I
170 ENDPROC
```

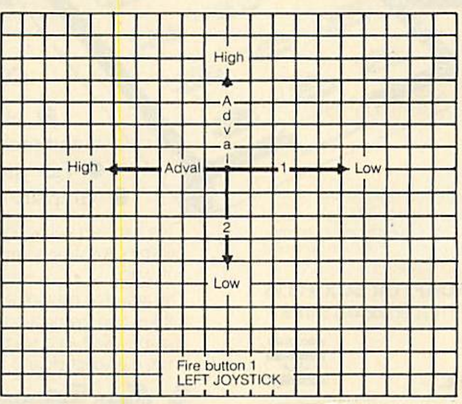
Listing 4.

£5 JOYSTICK CONNECTIONS

TOM BOYD of Seaford College writes to point out the lack of standardisation in joysticks. The Acorn joysticks do not operate quite as expected. In the horizontal axis, moving the joystick to the left increases the voltage to the analogue socket and does not reduce it as one would think. Acorn joysticks are obviously the standard and it would help if other manufacturers and software publishers would follow this standard. Diagram 1 shows the correct connections for Acorn joysticks.

Listing 5 gives a short program to display the ADVAL readings for either joystick. It can help identify the left and right joysticks (why aren't they labelled?). It can also be used to check for non-standard joysticks, or simply to check that they work correctly. Don't worry if your joysticks don't reach the maximum or minimum values (65536 and 0) – they seldom do! Any value within 100 of these values is satisfactory.

If you have non-standard joysticks they can be altered, provided the cases can be opened. Unplug the joysticks from the computer before opening the case to avoid any possible damage to the analogue-to-digital converter chip. It is usually the horizontal-movement potentiometer which is wired incorrectly. Check which potentiometer moves when the *joystick is moved* horizontally (or vertically, if that one is incorrect). There are three solder tags on the potentiometer each with wires. Leave the wire *on the middle* of the three tags and unsolder the wires on the others. Swap them round and resolder. The potentiometers are not particularly heat-sensitive, so this task is not difficult.



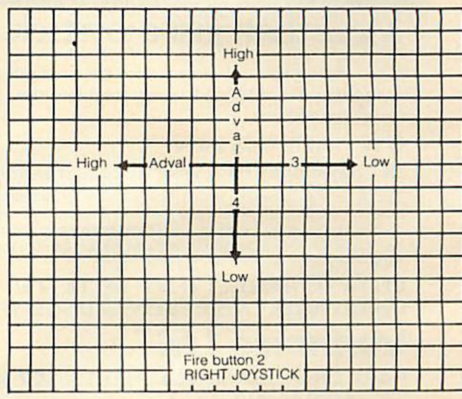


Diagram 1. Joystick movement

```
  1 REM listing 5
 10 REM Joystick tester
 20 @%=15
 30 INPUT"LEFT(0) OR RIGHT(1) "J%
 40 IF J%<0 OR J%>1 THEN GOTO 30
 50 REPEAT
 60 X=0:Y=0
 70 FOR N=1 TO 100
 80 X=X+ADVAL(1+2*J%)
 90 Y=Y+ADVAL(2+2*J%)
100 NEXT N
110 IF J%=0 THEN PRINT"LEFT JOYSTICK:    ";
120 IF J%=1 THEN PRINT"RIGHT JOYSTICK:   ";
130 PRINT "X=";INT(X/100),"Y=";INT(Y/100)
140 UNTIL 0
```

Listing 5.

FIRST AID FOR CASSETTES

WHILE on the subject of hardware, I often get enquiries about faulty computers. The usual question is: 'My computer has broken. Where do I send it to be repaired?' My first response is to ask what is wrong with it, and the answer usually is that it will not load from cassette. On a similar theme, I get: 'The cassette has broken. . . the motor won't work'.

Out of well over 50 such enquiries the following facts have emerged:

- The computer is seldom faulty. I can remember only two that needed to be sent back, and both exhibited the fault from new.
- The commonest fault is broken leads. Being frequently plugged in and unplugged, they soon break.
- The cassette or monitor is seldom broken.

- Cassette recorders need maintenance. They were not designed for the rigours of computing and need coaxing to function efficiently.
- Minor faults can occur in the computer if it is frequently moved about. These can often be put right easily.

It might be a useful feature of this column to highlight some of the simple faults that occur with the computer system and suggest first-aid measures that will get you going again.

This month I'll deal with the commonest fault by far: broken cassette leads. This accounts for about 90 per cent of the faults I've encountered. Mostly they break in the plug, but if the wire core is thin it can break in the middle of the lead and cause intermittent faults.

There are a bewildering variety of plugs and sockets on the computer and it would be useful to look at these first. Two types of plug can be used for cassette leads, DIN plugs and miniature jack plugs. Diagram 2 shows some of the possible configurations of the pins on a DIN plug. Although the number of pins and their configuration varies, the outline shape remains the same.

We are interested in two sizes of plug, 2.5mm and 3.5mm. They can have either a plastic barrel or a metal one. Avoid the latter if you can, for although they are stronger they can cause electrical problems.

The computer needs a seven-pin DIN plug for the cassette port, although a five-pin plug will do if motor control is not going to be used. At the cassette end things are not so simple. Most cassette recorders have a DIN socket and a number of jack sockets. Experience has shown that in the majority of cases the earphone and microphone sockets are best avoided and the DIN socket be used instead. The DIN plugs used are the seven-pin or the five-pin DIN (type A). If you look carefully at the solder side of the plugs you will see they are numbered as in diagram 3.

Three types of cassette should be considered. First, the Ferguson 3T07, supplied by Acorn. This cassette has been modified by Acorn so that the motor control comes out of pins 4 and 5 of the cassette DIN socket. Also, the internal microphone has been disconnected.

Acorn stopped supplying this cassette about a year ago.

Second, the BBC data cassette currently supplied for the BBC computer. This has a seven-pin DIN socket and the motor control uses pins 6 and 7 on the cassette DIN socket.

Third, other cassettes, including a standard Ferguson 3T07 not modified by Acorn. Most types will work, but I would dispute the oft-quoted *'The cheaper they* are, the better' rule.

To have motor control the remote socket needs to be used as well as the five-pin (type A) DIN socket. The remote socket is a 2.5mm *jack socket.*

The wiring of each type of lead is shown in diagram 4. To prolong the life of the cassette leads:

- Do not disconnect the cassette lead to rewind or wind the tape. There is no need to rewind the tape after use; the library case will keep it from being damaged. To rewind the tape before use, wait until the 'Searching' message appears then rewind before playing.
- Mount the computer and cassette on a single board with a small lip to prevent them falling off. This saves having to unplug them.
- Never pull the lead out by the wire; always grip the body of the plug.
- It is worth keeping a spare lead – they cost about £2 each – or at least make a note of which colour wire goes to which pin so that if the lead does break it can be repaired easily.

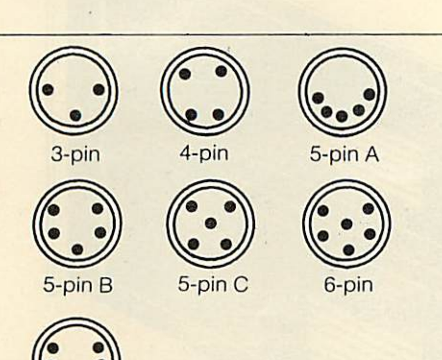


Diagram 2. DIN plug and its pin configurations

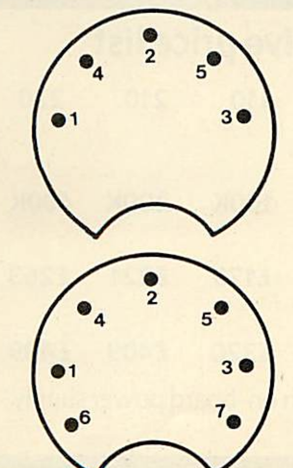


Diagram 3. DIN plug pin numbers, solder side

7 pin plug		5 pin plug	
pin 1	to	pin 1	*Record*
pin 2	to	pin 2	*Earth*
pin 3	to	pin 3	*Play*
pin 6	to	pin 4	*Motor control*
pin 7	to	pin 5	*Motor control*

Lead connections, modified Ferguson 3T07

7 pin plug		5 pin plug	
pin 1	to	pin 1	*Record*
pin 2	to	pin 2	*Earth*
pin 3	to	pin 3	*Play*
pin 6	to	pin 6	*Motor control*
pin 7	to	pin 7	*Motor control*

Lead connections, Acorn data cassette

7 pin DIN		5 pin DIN
pin 1	to	pin 1
pin 2	to	pin 2
pin 3	to	pin 3
pin 6 } pin 7 }	wired to a 2.5mm jack plug (polarity not important)	

Lead connections, other cassette types

Diagram 4. Wiring for cassette leads

QUICK TAKES

The first two are from Ewan MacLeod, and the third from Kevin Crosbie.

■ If you have more than one FOR. . .NEXT loop ending at the same point, there are three ways of writing the NEXT:

```
NEXT A:NEXT B
NEXT A,B
NEXT ,
```

By not specifying the variable in the NEXT statement, the program is speeded up.

■ LIST cannot be inserted as a program line. It can be used with an ON ERROR statement:

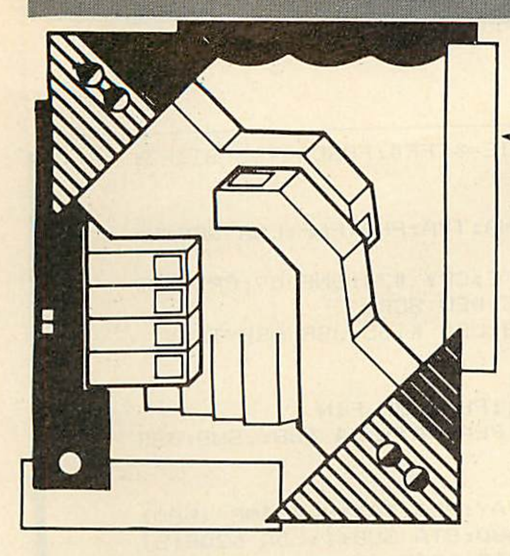
```
ON ERROR LIST
```

This will list the program if an error occurs, or if ESCAPE is pressed.

■ Instructions on Electron programs written in the BBC's mode 7 have odd shapes on the screen where the control characters were. To get round this add the following lines at the start of the program to change the control characters to appear as spaces

```
1 *FX20
2 FORA%=129 TO 254:VDU23,A%,
  0,0,0,0,0,0,0,0:NEXT
```

This routine will not take care of double-height characters. They are still printed out twice.



THE Forum's aim is to exchange ideas, tips and applications for BBC micro and Electron. Chaired by Ian Birnbaum, it enables more experienced programmers to present ideas, which must draw on earlier Forums or be original. *In either case, it should be* described clearly and fully, with listings supplied. At least £5 will be paid for any tip published. The main judging criteria are originality, and skill in implementing a routine. Your contribution should be typed or printed, with any substantial listings on cassette, but only included to make a point.

£5 RESET TIPS

by C Bowerman

ACORN do not provide a routine to clear resident integer variables. However, the following will clear them to zero:

```
FORA%=&408TO&468:?A%=0:
NEXT:!&404=0
```

Acorn's Clear command not only re-sets variables but PROCs etc as well. Clear can, therefore, not be used in PROCs. The following line clears variables but leaves PROCs etc intact; it can thus be safely used in procedures:

```
!&70=A%:FORA%=&482 TO&4F4:
?A%=0: NEXT:A%=!&70
```

On OS 0.1 there is no command to reset the function keys so that they contain nothing. The following does just that:

```
FORA=0 TP&11:A?&B00=17:NEXT
```

If you have ever hard re-set the computer and then regretted having lost all your function key definitions the following may be of use to you. Each time you alter the contents of a function key type the following:

```
F.A=0TO&11:A?&D50=A?&B00:N.
```

This saves the pointers cleared by Break. After Hard Reset type the following, which will retrieve the pointers saved previously:

```
F.A=0TO&11:?&B00=A?&D50:N.
```

The function keys will now function as before.

£5 LIST IN COLOUR

by John Marsden

ADD colour to your listings with the program shown in listing 1.

Having run the program, pressing function key f0 calls a small initialisation routine that redirects the operating system write character routine <OSWRCH> to &A00. Assembled at this location is a small machine code program that checks for a carriage return. When one is detected a colour control code is sent to the VDU drivers, with the result that each line is printed in a different colour.

```
20 REM by John Marsden
30 oswrch=!&20E AND &FFFF
40 FOR Z=0 TO 3 STEP 3
50 P%=&0A00
60[OPTZ
70 CMP#&D
80 BNE notcr
90 LDA#&D:JSR oswrch
100 LDA&80:JSR oswrch
110 INC&80
120 LDA&80
130 CMP#136
140 BNE miss
150 LDA#129:STA&80
160 .miss RTS
170 .notcr JSR oswrch
180 RTS
190]
200 P%=&900
210[OPT Z
220 .init
230 LDA#129:STA&80
240 LDA#0:STA&20E
250 LDA#&A:STA&20F
260 LDA#12:JSR oswrch
270 RTS
280]
290 NEXT Z
300 *KEY 0 CALL&900:M
```

Listing 1. Prints every line of your listings in a different colour

£5 ECONET LOADING

by Alan Clarke

I RECENTLY encountered a loading difficulty while using a level 1 Econet system (BBC micros), and am offering an interim solution for users who may have the same problem. I am sure the addition of a second processor with level 2 will solve it, but in the meantime we have only a level 1 system (and still no level 1 documentation yet).

As an example, I will take '&.FLAGS' by Anita Straker. (For public access on each station, the program has to be named '&. FLAGS' to run on the Econet FS).

On loading '&.FLAGS' under normal DFS on the file-server, without Econet in operation, there was no problem. However, on initiating the Econet system and then trying to load 'FLAGS' into an Econet station, the message 'too much data' appears on the station's VDU.

A provisional solution (I am still working on it) is to do the following (which effectively splits the program into two sub-programs which are then loaded separately):

1. Stay in normal DFS mode at the file-server
2. Type in *OPT1,2<return>
3. Type in *LO.&.FLAGS 1900 <return>

The following information appears on the VDU:

	Load Address	Execute Address	Length of prog.	
$.&.FLAGS	FF 1900	FF 801F	00 3718	03A

	Load Address	Length	Execute Address	
4. Type in *SA.&.FLAGS/1	1900	+2000	801F	<return>
5. Type in *SA.&.FLAGS/2	3900	+1718	1900	<return>

You are now in a position to load the 2-part program on the Econet system.

6. Boot the Econet system using the level 1 FS disc
7. At any Econet station type in:

PAGE=&1900	<return>
*LO.FLAGS/1	<return>
*LO.FLAGS/2	<return>
END	<return>
RUN	<return>

You should now have the program running successfully at the Econet station.

My next move will be to try the same method with any machine-code program, and I would welcome any comments from any other level 1 Econet users.

WE WOULD certainly be interested in hearing from readers about this.

£5 SCREEN CHECK

WHEN planning or printing screens in mode 7, it may be necessary to print many colour codes, graphics characters and so on dotted about the screen, with perhaps many on one line at a time, spaced out. Unfortunately, when filling the screen, some of these characters may be overwritten, resulting in the whole line reverting to white alphanumerics. Or, if the screen accidentally scrolls, the upper line of the display will be lost, and the whole screen one line out of place.

The following program (listing 2), which will only work in mode 7, intercepts OSWRCH and checks if it is overwriting any colour or graphics code (range 129-160) If it is, it moves the text one place forward and checks again – and so on, until it reaches a clear patch. It also checks whether scrolling will occur if it prints the character, and if it will, moves the cursor one line up. When the program is run, the screen will scroll once, and then never again.

The intercept routine will work only with OS 1.0 or higher. The routine is at &0D00, so those with the disc interface will have to change this. It is activated with CALL ST, and deactivated with CALL EN.

The real address of OSWRCH is shifted to &80 and &81. Any alteration of these locations by a user's program will prove 'fatal'!

THIS program was sent in by a Southampton reader who forgot to add his/her name to the letter. If he/she sends in another letter, signed this time, we will know who to make the £5 cheque payable to.

```
   10 OSWRCH=&FFEE:OSBYTE=&FFF4:FORC=0TO3 STEP3:
P%=&0D00
   20 [OPTC
   30 STA &88:PHA:TXA:PHA:TYA:PHA:PHP:LDA &88:PH
A
   40 LDA #134:JSR OSBYTE:CPY #24:BNE 09:CPX #39
:BEQ SCR:PLA:PHA:CMP #13:BEQ SCR
   50 .09:LDA #9:STA &88:LDA #135:JSR OSBYTE
   60 CPX #129:BCC FIN
   70 CPX #160:BCS FIN
   80 PLA:CMP #32:BCS 01:PHA:JMP FIN
   90  .01: PLP:PLA:TAY:PLA:TAX:LDA &88:.SUB:JSR
 &FFFF
  100 PLA:JMP (&80)
  110 .FIN:PLA:PLP:PLA:TAY:PLA:TAX:PLA:JMP (&80)
  120 .ST:LDA &20E:STA &80:STA SUB+1:LDA &20F:ST
A &81:STA SUB+2:LDA #0:STA &20E:LDA #&0D:STA &20
F:RTS
  130 .EN:LDA &80:STA &20E:LDA &81:STA &20F:RTS
  140 .SCR:LDA #11:STA &88:PLA:CMP #13:BEQ 01:CM
P #32:BCS01:PHA:JMP FIN
  150 ]:NEXTC
  160 END
```

Listing 2. Prevents overwriting of colour or graphics codes

£5 ERRORS UNKNOWN

by Duncan Breckels

I HAVE a BBC B with OS 1.2 and Basic II. In the process of using it I have come across several error messages which are not documented in the *User Guide*. For instance, on page 447 it says that error no. 45 is a 'new' one. This is not the case, as the Basic ROM already contains error 45 which is "Missing #". I have therefore had a look through the machine's ROM and found several other error messages that are not documented. Some of these I have been able to generate at one time or another; others (such as no. 250) are rather more puzzling. They are:

213 Locked
214 File not found – Result of Shift/Break or of a 'Load' type command in ROM mode
215 Bad ROM
247 OS 1.2 – Result of *FXO but not of *HELP, which does not generate an error
249 Language?
250 Key in use
251 Bad key – Incomprehensible *KEY command or one there is not space for
252 Bad address
253 Bad string – Result of trying to SAVE etc with a name longer than 10 chars
254 Bad command – Anything after * that the OS doesn't understand.

SECRET SYMBOLS £5

by Robert O'Leary

HERE are two *KEY functions which could be of help in program protection:

*KEY 0 FOR C=PAGE TO TOP: IF ?(C)=ASC"¼" ?(C)=21:NEXT ELSE IF ?(C)="¾" ?(C)=6:NEXT ELSE NEXT IIM
*KEY 1 FOR C=PAGE TO TOP: IF ?(C)=21 ?(C)=ASC"¼":NEXT ELSE IF ?(C)=6 ?(C)=ASC"¾":NEXT ELSE NEXT IIM

When a program is being written, ¼ symbols (in mode 7) can be inserted inside PRINT or REM statements where a 'VDU off' is required, and ¾ symbols can be inserted to turn the VDU back on.

If f0 is depressed, the computer looks through the program character by character. Whenever ¼ is encountered, 21 (the control code which turns off the VDU) is poked in its place, and whenever ¾ is encountered, 6 is poked in its place (6 being the ASC value of the control code which re-enables the VDU)

Pressing f1 will simply restore the program to its original structure.

If the codes are strategically positioned throughout a program, any sections you wish to remain secret will do so, without giving the impression that the program is even protected.

COLD TURKEY £5

by Alex Selby

I HAVE devised a short machine code interrupt-driven routine that will enable you to freeze what the computer is doing so that you can see what is going on, answer the phone, cheat at a game, etc.

First decide by which key you want to control the 'freeze-framing', then look up its number on page 275 of the *User Guide*. I often use f0, the number of which is −33. Next, type in the following, remembering to set K% equal to the number of the key you have chosen:

```
K%=-33:P%=&D80:[OPT2:.T%:LDA
#129:LDY#255:LDX&42C:JSR&FFF4:CPY
#255:RTS:.I%:JSRT%:BEQP%+3:RTS:
LDA&25A:PHA:EOR#48:STA&25A:
JSR&EEDA:JSRT%:BEQP%-3:JSRT%:
BNEP%-3:JSRT%:BEQP%-3:PLA:
STA&25A:RTS:]:?&220=I%:
?&221=I%DIV256:*FX 14,4
```

The P%=&D80 could be changed to another location, say, &900. A line number could be added in front to incorporate this into a Basic program.

I you want it to survive a "soft" break then type:

*KEY10"?&220=I%:?&221=I% DIV256: *FX 14,4 IIM"

Altering K% after the routine has been initialised will affect it, since &42C is the address where the value of K% is stored. K% should not therefore be used in the main program. To let you know when the computer is 'frozen', the Shift-lock and Caps-lock LEDs will reverse during this period. To operate the 'freeze', press the chosen key. Press it again to 'unfreeze' the computer.

This routine will only work on the 1.2 operating system, although all Basics should tolerate it.

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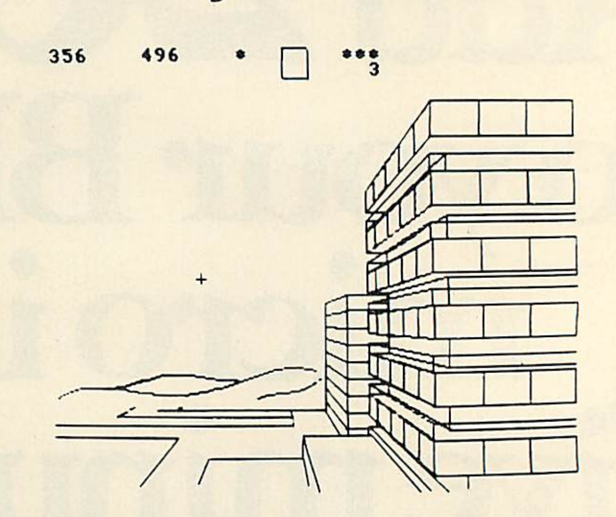
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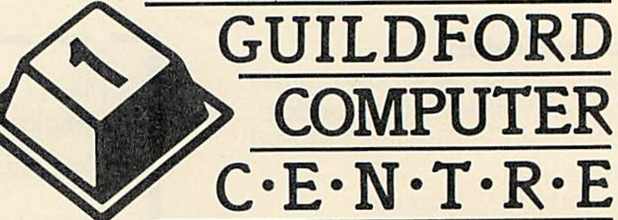
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David Barnett shows you how to make a disc readable on both 40 and 80 track drives

DOUBLE-HEADER

BBC disc drives come in two varieties—one records 40 tracks per side of disc and the other 80. With the exception of track 0, it is not normally possible to read one type of disc on the other type of drive. This presents a problem for the software distributor. Should he manufacture two kinds of disc?

He will be reluctant to do so because there are far fewer 80-track systems in the field than 40s and it would be rather expensive to support such a small market with a separate product. For this reason some distributors ignore the 80-track market altogether.

One solution is to record 40-track data on side zero of the disc and 80-track data on side two. This procedure has two disadvantages: double-sided discs are more expensive than single-sided ones; and the Shift/Break auto-boot facility cannot be used by the 80-track version because it is on side two.

What is required is a method of recording both sets of data on the same side of the disc in such a way that each kind of drive automatically picks up the correct type of data. To find the method you have to understand the track structure of a disc and why the two disc types are incompatible.

Figure 1 shows the scheme of tracks for the two types of disc. The outermost track is track 0. This is common to both 40 and 80 track discs. Here the disc catalogue is recorded because it is the part of the disc which moves fastest past the read/write head and so is the most reliable. It is also the 'home' position for the head.

The other tracks are concentric rings, with the inner tracks taking the higher numbers. Eighty-track discs have tracks twice as close together as 40-track discs, so that track number 30 on the 80-track system corresponds to the position of track 15 on the 40-track system.

A further complication arises because of formatting. When the disc is formatted, each track is divided into 10 sectors of 256 bytes. Every sector begins with field of bytes describing the sector. Part of the description comprises the track number and the sector number. These are used by the disc controller chip (Intel 8271) to verify that it has found the sector requested by the disc software. If the physical position of the head does not match the identification on the disc then the 'disc fault' message will be produced.

Figure 2 shows the track structure for a simple dual-format disc. The disc is divided into four regions:

A. Track zero, which is common to both disc types.
B. Tracks 1 to 19 – unused.
C. Tracks 20 to 39 – '80 track' formatted region.
D. Tracks 20 to 39 – '40 track' formatted region.

The data are recorded twice—once in each of regions 'C' and 'D'. Notice that the '40 track' region 'D' is entirely inside the ring of the 80 track region and does not overlap it. The catalogue is common, being on track zero.

When the disc is placed in a 40-track

Listing 1. Deceives the 8271 disc controller chip

```
    5 MODE7
   10 PRINT "DUAL 80/40 TRK DISC MAKER"
   20 PRINT "(C) DAVID BARNETT 21/08/83"
   25 PROC_INFO
   30 PROC_ASK_DRIVES
   35 Z%=@%:@%=2
   40 PROC_INIT
   45 PROC_SEEK(0)
   50 X=FN_COPY_80_TO_40
   55 PROC_SEEK(0)
   60 IF X<> 0 THEN PROC_ERROR(X)
   65 @%=Z%
   70 END
   90
  100
  110 DEF PROC_INFO
  120 PRINT
  130 PRINT"An 80 track drive is used th
roughout."
  140 PRINT
  150 PRINT"The disc must have been prep
ared by the"
  160 PRINT"following steps:"
  170 PRINT'"1) FORMAT Using *FORM40"
  180 PRINT "2) *SAVE DUMMY1 0 800"
  190 PRINT "3) *SAVE DUMMY2 0 BE00"
  200 PRINT "4) *DE. DUMMY1"
  210 PRINT "5) *COPY the wanted files t
o this disc."
  220 PRINT
  230 ENDPROC
  240
  250
 1000 DEF PROC_ASK_DRIVES
 1010 D40=FN_ASK_INT("WHICH DRIVE HAS TH
E DISC? ",0,3)
 1020 D80=D40
 1060 ENDPROC
```

continued on page 70

drive the *DFS will read the* catalogue on track zero which will point to files living somewhere on tracks 20 to 39. Because it is a 40-track drive the head will be stepped to region 'D' and the 40-track data read. If it were an 80-track drive the head would be stepped only half as far and would read 80-track data from region 'C'.

I'll call this scheme the '20/39 format' because the data are recorded on tracks 20 to 39 and track 0 only.

The 20/39 format is good provided that no more than 52k of data need be stored on the disc. In fact, this applies to most software currently being distributed and in particular to games; after all, the Beeb has only 32k of RAM in all, of which only 24k are available on a disc system in mode 7.

The procedure to make a dual disc is in six simple stages, carried out using an 80 track drive:

1. Format a disc using *FORM40. This will create an '80 track' region from tracks 0 to 39.
2. *SAVE DUMMYa 0 800
   This command creates a dummy file which will occupy the remainder of track zero after the catalogue.
3. *SAVE DUMMYb 0 BE00
   This creates another dummy file which will occupy tracks 1 to 19 and so prevent them from being used by real files.
4. *DELETE DUMMYa
   To release the track zero space for use by real files.
5. *COPY the wanted files to the prepared disc.
6. Run the Dual 40/80 track disc, making program listed as listing 1.

*BACKUP (after *ENABLE) may be used to copy the discs on to other *FORM40 discs using 80 track drives but only the '80 track' region will be copied. The Dual 40/80 maker will have to be run on each copy.

Program description

The program in listing 1 has a very simple structure shown in lines 5 to 70.

PROC_INFO prints some information about the use of the program. The procedure begins on line 110.

PROC_ASK_DRIVES asks the user to specify the drive number of the disc to be converted. The drive number is returned in D40 and D80. The procedure begins on line 1000.

PROC_INIT sets up parameter blocks for OSWORD calls &7F which make direct access to the 8271 disc controller chip. There are five different functions to be performed, each requiring its own parameter block:

a) Read track	(P80)
b) Write track	(P40)
c) Seek track	(SEEK40)
d) Set track count	(SET40)
e) Format track	(FMT40)

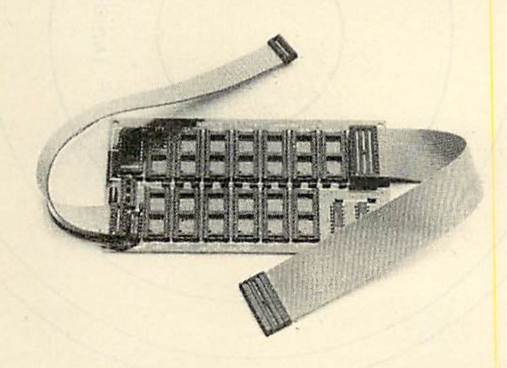
The 'Set track count' call is used to deceive

continued from page 69

```
 1090
 1099
 1100 DEF FN_ASK_INT(M$,MIN%,MAX%):LOCAL
N%
 1102
 1104 REM ASK FOR INTEGER INPUT IN THE
 1106 REM RANGE MIN% TO MAX%.
 1107 REM  PROMPT STRING IS M$
 1109
 1110 REPEAT
 1120 PRINT M$;:INPUT""N%
 1130 IF N%<MIN% OR N%>MAX% THEN PRINT"M
UST BE IN THE RANGE ";MIN%;" TO ";MAX%
 1140 UNTIL N%>=MIN% AND N%<=MAX%
 1150 =N%
 1160
 1199
 1200 DEF PROC_INIT
 1202
 1204 REM SET UP PARAMETER BLOCKS FOR DI
SK ACCESS
 1206
 1210 DIM BUF &31FF :REM 5 TRACKS
 1220 P40=FN_RW_PARMS(&FF,&4B)
 1230 P80=FN_RW_PARMS(D80,&53)
 1232 SEEK40=FN_CTRL_PARMS(D40,1,&69,1,0
,0,0)
 1234 SET40=FN_CTRL_PARMS(&FF,4,&35,&10+
8*(D40 MOD2),&FF,&FF,0)
 1240 OSWORD=&FFF1:OSBYTE=&FFF4
 1245 DIM FBUF 39
 1247 FMT40=FN_FMT_PARMS(&FF,FBUF)
 1250 ENDPROC
 1260
 1270
 1280
 1290 DEF FN_RW_PARMS(DR,CMD)=FN_CTRL_PA
RMS(DR,3,CMD,0,0,&2A,0)
 1295
 1300 DEF FN_CTRL_PARMS(DR,NPRM,CMD,P1,P
2,P3,P4):LOCAL B%
 1302
 1304 REM SET UP DISC CONTROLLER PARAMET
ER BLOCK
 1305 REM AND RETURN ITS ADDRESS
 1306
 1310 DIM B% 11
 1320 ?B%=DR:B%!1=BUF:B%?5=NPRM:B%?6=CMD
:B%?7=P1:B%?8=P2:B%?9=P3:B%?10=P4
 1330 =B%
 1390
 1399
 1400 DEF FN_COPY_80_TO_40:LOCAL X,FLG:F
LG=0
 1405
 1406 REM CREATE "40 TRK" COPY OF TRACKS
 20 TO 39
```

continued on page 72

ROM extension board for the BBC Micro



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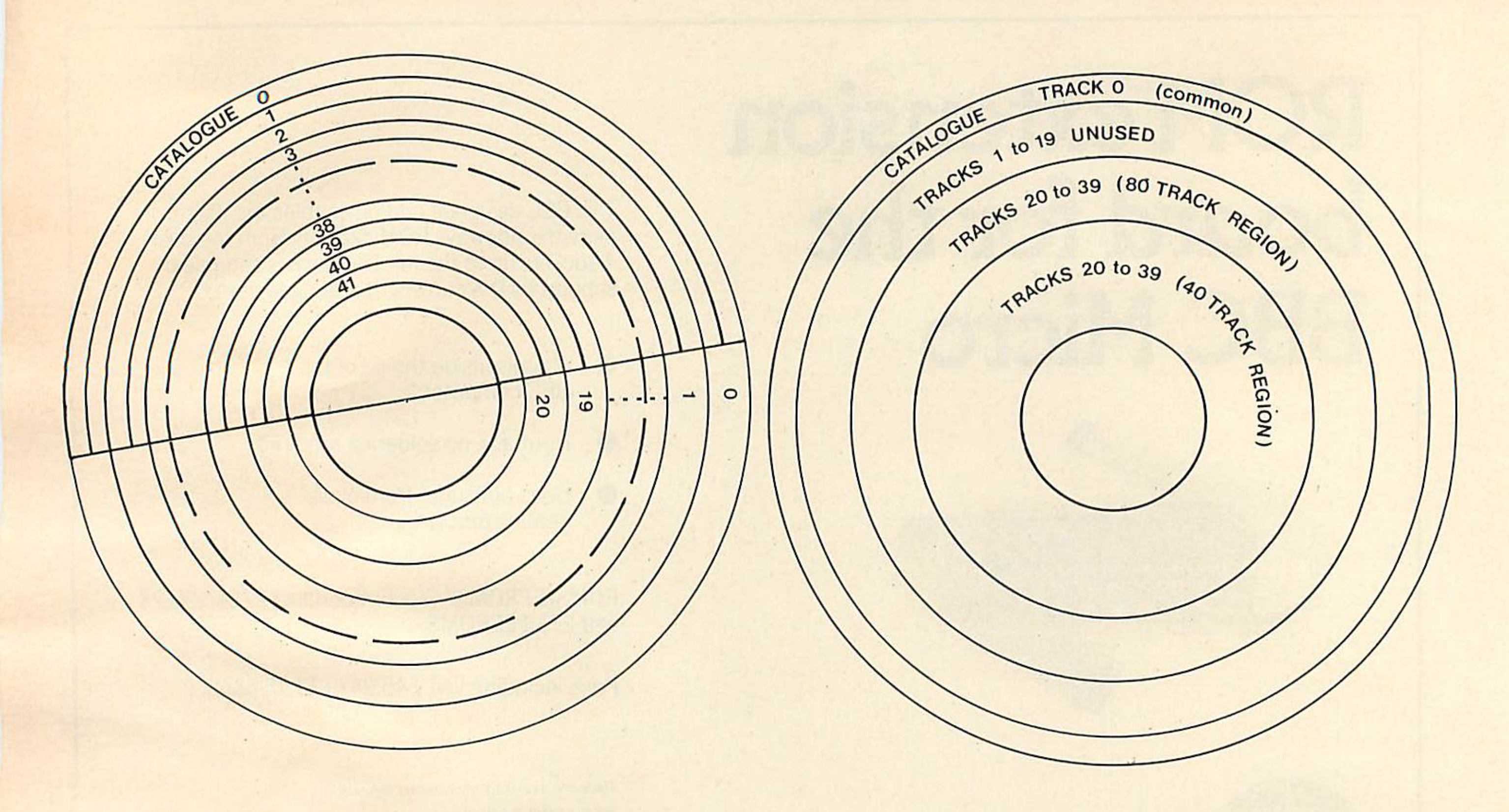


Figure 1. Disc track scheme for both types of disc

Figure 3. Dual format disc structure

continued from page 70

```
 1410
 1420 FOR TRK=20 TO 39 STEP 5
 1424 PRINT"Copying tracks ",TRK," to ",
TRK+4;"  R";
 1425 PROC_SEEK(0)
 1430 FLG=FN_READWRITE_5TRACK(TRK,P80)
 1435 PROC_SEEK(TRK):PROC_SET(0)
 1445 VDU8:PRINT"W";
 1450 X=FN_READWRITE_5TRACK(TRK,P40):IF
X<>0 THEN=X
 1454 PRINT
 1455 IF FLG<>0 THEN=FLG
 1460 NEXT
 1470 =0
 1480
 1510
 1520 DEF FN_READWRITE_TRACK(TRK,PARM)
 1521
 1530 PARM?7=TRK:PARM?10=0
 1540 X%=PARM:Y%=PARM/256:A%=&7F:CALL OS
WORD
 1550 =PARM?10
 1560
 1570 DEF PROC_ERROR(X)
 1580 PRINT"DISK ERROR ",X
 1590 ENDPROC
 1600
 1601
 1610 DEF PROC_SKP40(TRK)
 1612
 1614  REM FOOL DISK CONTROLLER INTO SKI
PPING
 1616  REM A TRACK BY WRITING TRK-1 TO I
TS
 1618  REM COUNT REGISTER.
 1619
 1620 IF TRK=0 THEN PROC_SEEK(1):PROC_SE
T(0) ELSE PROC_SET(TRK-1)
 1630 ENDPROC
 1640
 1699
 1700 DEF PROC_SEEK(TRK)
 1702
 1704 REM DISK CONTROLLER SEEK COMMAND
 1706
 1710 SEEK40?7=TRK:SEEK40?8=0
 1720 X%=SEEK40:Y%=SEEK40/256:A%=&7F:CAL
L OSWORD
 1730 IF SEEK40?8<>0 THEN PROC_ERROR(SEE
K40?8)
 1740 ENDPROC
 1750
 1799
 1800 DEF PROC_SET(TRK)
 1802
 1804 REM SET TRACK COUNT REGISTER IN DI
SK CONTROLLER
 1806
 1810 SET40?10=TRK:SET40?11=0
 1820 X%=SET40:Y%=SET40/256:A%=&7F:CALL
OSWORD
 1830 IF SET40?11<>0 THEN PROC_ERROR(SET
40?8)
 1840 ENDPROC
 1890
 1899
 1900 DEF FN_READWRITE_5TRACK(TRK,PARM)
```

the 8271 controller into thinking that the track count is only half its true value. In this way a 40-track format disc may be written on an 80-track drive. The procedure begins on line 1200.

PROC_SEEK (0) performs a 'Seek track zero operation' that sets both the drive and controller into a known state (ie, head really at track zero and track count also zero). The procedure begins on line 1700.

FN_COPY_80_TO_40 copies tracks 20 to 39 from the 80-track region into the 40-track region, formatting as it goes. The function performs the copy in groups of five tracks to improve the efficiency. The value of the function is zero unless a disc error has occurred. The function begins on line 1900.

PROC_SEEK (0) sets the system into a known state after all the manipulations of the program.

PROC_ERROR is called in the event of an error in order to print the error number. The procedure begins on line 1570.

The main copy routine, FN_COPY_80_TO_40, moves from tracks 20 to 39 in steps of five and calls the following routines:

FN_READWRITE_5TRACK is called twice: first to read five tracks from the 80-track region into a buffer, and then again to write five tracks into the 40-track region. The two operations are distinguished by the parameter block, which is passed to it as a parameter. The function begins on line 1900.

PROC_SET (0) is called with the record head at the beginning of a group of 5 (TRK). It sets the controller's count register to zero. When the next 'SEEK (TRK)' command is given by the read/write routine the head will be moved to position 2*TRK, which is where a 40-track drive would expect it to be.

The 20/39 dual disc format could greatly simplify the problem of supporting the two official disc formats. The program described above produces 'unprotected' discs.

An analagous scheme for producing dual-format protected discs can be written as a small modification of the program itself.

Given the desirability of using dual-format discs to distribute software, 20/39 format has the advantages of simplicity and transparency (from both user and programmer points of view). The drawback is that half the disc must remain unused. This will not matter, however, for most games applications.

Lastly, it would be more convenient if a dual-disc maker could behave like *COPY. Such a program would have to duplicate the operation of OSFILE in the DFS because the DFS knows nothing of dual-format discs. It presents a challenge to the more advanced reader of *Acorn User* to write one. There might even be some money in it! ●

```
 1901
 1905 LOCAL NERR,DRIVE:NERR=10
 1906 DRIVE=PARM?0
 1910 PARM!1=BUF
 1920 LOCAL I,N
 1930 FOR I=0 TO 4
 1935 IF I>0 AND PARM=P80 THEN PARM?0=&F
F
 1936 PRINT TRK+I;:VDU 8,8
 1938 IF PARM=P40 THEN PROC_SEEK(TRK+I):
X=FN_FMT(TRK+I):IF X<>0 THEN=X
 1940 REPEAT
 1942 X=FN_READWRITE_TRACK(TRK+I,PARM)
 1944 NERR=NERR+(X<>0)
 1946 UNTIL NERR<=0 OR X=0
 1948 IF X<>0 THEN=X
 1950 IF PARM=P40 THEN PROC_SKP40(TRK+I)
 1960 PARM!1=PARM!1+2560
 1970 NEXT
 1975 PARM?0=DRIVE
 1980 =0
 1990
 1999
 2000 DEF FN_FMT_PARMS(DR,BUF):LOCAL B%,
I%,ID
 2010 DIM B%12
 2020 ?B%=DR:B%!1=BUF
 2030 B%?5=5:B%?6=&63:      REM FORMAT
 2040 B%?8=27-6       :      REM GAP3-6
 2050 B%?9=&2A        :      REM 256 BYTE S
ECTORS * 10
 2060 B%?10=0         :      REM GAP5-6
 2070 B%?11=22-6      :      REM GAP1-6
 2080 REM        SET UP ID FIELDS (EXCEP
T TRACK)
 2090 FOR I%=0 TO 9
 2100 ID=BUF+4*I%
 2110 ID?1=0          :REM HEAD
 2120 ID?2=I%         :REM SECTOR
 2130 ID?3=1          :REM LENGTH 256 BYTES
 2140 NEXT
 2150 =B%
 2160
 2170 DEF FN_FMT(TRK): LOCAL I%
 2180 FMT40?7=TRK
 2190 FMT40?12=0
 2200 FOR I%=0 TO 39 STEP 4
 2210 FBUF?I%=TRK
 2220 NEXT
 2230 X%=FMT40:Y%=FMT40 DIV 256
 2240 A%=&7F
 2250 CALL OSWORD
 2260 =FMT40?12
```

MODISH ADDRESSES

Michael Murray gives the lowdown on screen memory organisation to enable you to poke directly to it

BECAUSE the screen on the BBC micro is handled by the machine operating system in machine code (using the sub-routine OSWRCH at &FFEE and vectoring via WRCHV at &20E), the manual gives no details of how the screen is arranged. The screen organisation is not straightforward as it varies from mode to mode and is determined by the resolution and the number of colours available. You have to understand the screen memory organisation if you wish to poke directly to it.

Mode	Difference in Memory Addresses	
	Between characters	Between lines
0	8	640 (&280)
1	16 (&10)	640 (&280)
2	32 (&20)	640 (&280)
3	8	640 (&280)
4	8	320 (&140)
5	16 (&10)	320 (&140)
6	8	320 (&140)
7	1	40 (&28)

character 1	character 2	character 3
&n.n.00	&n.n.08	&n.n.10
&n.n.01	,	,
&n.n.02	,	,
&n.n.03	,	,
&n.n.04	,	,
&n.n.05	,	,
&n.n.06	,	,
&n.n.07	&n.n.0F	&n.n.17

Figure 1. Each character position is represented by eight memory locations

Mode 7 is the simplest to explain and explore and is different from all the other modes. The screen memory exends from &7C00 (the top left-hand corner) to &7FE7 (the bottom right-hand corner). Each memory location represents a character position on the screen, and any value from 0 to 255 (&FF) may be poked to these locations; but be warned – values below 32 give control characters and can cause surprising or even disastrous results if used in this way. Poking to one of the screen memory locations will cause a whole character to be displayed on the screen, and the character produced will depend whether you're in teletext text or graphics mode. If the value poked is one of the teletext control characters, such as 130, then a space will be displayed, although the character will actually occupy that memory location.

These control characters are in the range 129-159, and poking them to the screen determines the colour of the background and foreground and whether the text or graphics character set is displayed. The mode 7 character sets and how to use them are well covered in the user handbook. Try this for a start:

```
MODE7          (sets mode & clears screen)
?&7F00=65      (prints 'A')
?&7F01=129     (selects colour red)
?&7F02=157     (sets background to selected colour)
?&7F03=131     (selects colour yellow)
?&7F04=97      (prints 'a' in the new colour)
```

The teletext control characters cannot be seen on the screen, although they are held in the screen memory and occupy space on the screen. The three spaces between 'A' and 'a' on the screen actually contain the control characters 129, 157, 131. Try the following:

```
?&7F01=130     (alters the control character to give a green background)
?&7F01=97      (substitutes 'a' for the control code)
```

In the second example the 'a' is printed but


DOC. SOFT

the background colour is changed to that of the 'a'. This is because that is the colour presently specified when the control code 157 is encountered at &7F02. Poking teletext control codes to the screen in this manner can give interesting colour changes in a program. Poking direct to the screen also enables easy alteration of a small part of a complete screen.

Modes 0, 3, 4 and **6** are two-colour modes, organised in a similar way. The screen memory addresses for these are:

Mode	*Top left*	*Bottom right*
0	&3000	&7FFF
3	&4000	&7E7F
4	&5800	&7FFF
6	&6000	&7F3F

The screen is organised as a series of character positions going from top left of the screen to bottom right. The number of positions on the screen depends on the mode, but each character position is organised in the same way, and represented by eight memory locations as shown in figure 1. The high byte, represented by 'nn' in figure 1, may be anywhere in the screen memory range. The bit-pattern contained in each memory location controls what is displayed, as shown in figure 2. This is easy to understand as it follows the same principle as that used to redefine characters using the VDU23 command. Try the example in listing 1, which will make the box shown in figure 2. Try it with line 10 set for each of the four two-colour modes and note that the character appears in a different place in each mode.

Modes 1 and **5** are four-colour and are also arranged as character positions, but their organisation is a little more complex than the two-colour modes, since each memory location contains colour information as well as the bit-pattern to be displayed. The screen addresses for these modes are:

Mode 1 &3000 to &7FFF
Mode 5 &5800 to &7FFF

Both modes are arranged in a similar way, each being controlled by 16 memory locations. Figure 3 illustrates how memory is arranged, the example shown being the first character position in mode 1. It will be seen that since each character is eight pixels wide each memory location must contain colour and bit-pattern data for four pixels. This is achieved by breaking the eight-bit byte in each memory location into two four-bit parts (nibbles), and arranging them as shown below. Assume that the memory location contains the value &59.

&59=01011001(binary)
most significant nibble=0101 ↓ *binary*
least significant nibble=1001 ↓ *read*
1203

If each column is treated as a two-bit binary number with the most significant bit at the top and the least significant bit at the bottom, then each column represents the decimal value shown in the bottom line. This value is the colour that that pixel will be set to. In this case the four pixels controlled by the memory location containing &59 will be set to each of the four available colours in the order 1, 2, 0, 3 from left to right on the screen. This may be demonstrated by:

```
MODE5: FOR I=0 TO
7:I?&7000=&59:NEXT
```

This will give vertical stripes of the four colours, although the red stripe may not show up very well. This will also work in mode 1 but will be more difficult to see. Now try:

```
MODE5
?&7000=&F0
?&7001=&F
?&7002=&FF
```

These give a line in one of the non-background colours as shown here:

&F0=11110000 MSN=1111 ↓ *binary*
LSN=0000 *read*
all pixels colour 2 2222

&F=00001111 MSN=0000 ↓ *binary*
LSN=1111 *read*
all pixels colour 1 1111

&FF=11111111 MSN=1111 ↓ *binary*
LSN=1111 *read*
all pixels colour 3 3333

Mode 2 is the 16-colour mode. The screen memory addresses are from &3000 to &7FFF.

The organisation of each character position is an extension of that employed

address	content: Hex	content: Binary
**00	&FF	11111111
01	&81	10000001
02	&81	10000001
03	&81	10000001
04	&81	10000001
05	&81	10000001
06	&81	10000001
07	&FF	11111111

(Display column: 8×8 grid showing a box outline.)

Figure 2. The bit-pattern in each memory location dictates what shape is displayed

&3000	&3008
&3001	&3009
&3002	&300A
&3003	&300B
&3004	&300C
&3005	&300D
&3006	&300E
&3007	&300F

Figure 3. The first character position in mode 1

&3000	&3008	&3010	&3018
&3001	&3009	&3011	&3019
&3002	&300A	&3012	&301A
&3003	&300B	&3013	&301B
&3004	&300C	&3014	&301C
&3005	&300D	&3015	&301D
&3006	&300E	&3016	&301E
&3007	&300F	&3017	&301F

Figure 4. Memory addresses for the first character position in mode 2

for the four-colour modes. The memory addresses of the first character position are shown in figure 4. It will be seen that each memory address contains the data for only two pixels. The colour of each pixel is obtained by breaking the eight-bit byte in the memory location into four two-bit pairs and arranging them as shown below. Each column produced by arranging the pairs in this way is then read as a binary number from top to bottom. For this example assume that the memory location contains &35:

```
&35=00110101
most significant pair= 00   |  binary
                       11   |  read
                       01   |
least significant pair= 01  v
                       ---
                        47
                       ---
```

Thus the left-hand pixel will be displayed as colour 4 and the other as colour 7. To calculate how to display a particular colour requires us to work in reverse. For example, if we want two pixels in colour 6:

```
  6=0110
    binary     00 most significant pair
    read 6     11
               11
               01 least significant pair
               ---
               66
               ---
```

The byte to generate this is 00111100, ie, &3C. Prove this by:

MODE2: ?&7000=&3C

This will display two adjacent pixels in colour 6 (cyan).

Poking directly to the screen is not to be undertaken lightly as it may have side-effects. For example, programs which poke direct to the screen will not run properly if the Tube is connected. The benefits of poking to the screen are doubtful if movement is wanted because of the difficulty of producing a suitable algorithm – the built-in routines make a good job of this. However, there are two modes in which screen pokes can be quite useful: modes 7 and 2.

In mode 7 it can be a powerful tool to alter small parts of a basically static display without having to reorganise the whole line or lines affected. In mode 2 it can be useful for producing small and irregular multi-coloured characters. Listing 2 is a simple demonstration of poking in mode 7. Lines 70, 120, 180 and 240 slow things down – if they are removed the program runs too quickly to see what is happening. Listing 1 shows one way of using pokes in a 'normal' mode, in this case mode 2 with several colours.

It is also possible to use the principles described here in assembly language programs to speed things up by addressing the screen directly instead of having to call an in-built operating system routine each time the screen is accessed.

```
   10 MODE2
   15 COLOUR130
   16 CLS
   20 FOR MEM%=&7000 TO &701F
   30   READ POKE%
   40   ?MEM%=POKE%
   50   NEXT
   60 END
   70 DATA&3F,&2A,&2A,&2A,&2A,&2A,&2A,&
3F,&3F,0,&F,&4B,&4B,&F,0,&3F,&3F,0,&F,&
87,&87,&F,0,&3F,&3F,&15,&15,&15,&15,&15
,&15,&3F
```

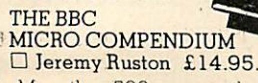
Listing 1. This produces the box shown in figure 2

```
   10 MODE7
   20 FOR L%=0 TO 23
   30   VDU132,157,13,10
   40   NEXT
   50 REPEAT
   60   FOR COLUMN%=3 TO 36
   70     B=INKEY(5)
   80     ?(&7C00+COLUMN%)=131
   90     ?(&7C01+COLUMN%)=64
  100     NEXT
  110   FOR L%=0 TO 22
  120     B=INKEY(5)
  130     ?(&7C25+L%*40)=132
  140     ?(&7C4C+L%*40)=131
  150     ?(&7C4D+L%*40)=64
  160     NEXT
  170   FOR COLUMN%=36 TO 3 STEP-1
  180     B=INKEY(5)
  190     ?(&7F98+COLUMN%)=131
  200     ?(&7F99+COLUMN%)=64
  210     ?(&7F9A+COLUMN%)=32
  220     NEXT
  230   FOR L%=22 TO 0 STEP -1
  240     B=INKEY(5)
  250     ?(&7C03+L%*40)=131
  260     ?(&7C04+L%*40)=64
  270     ?(&7C2C+L%*40)=132
  280     NEXT
  290   UNTIL FALSE
```

Listing 2. Poking in mode 7

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PLANNING & PLOTTING

Advice from Mike Austin of Level 9 Computing on how to weave your own adventure web

THERE are only two fundamental types of adventure games: graphical maze games (zap the baddies and escape) and text games (solve the puzzles and collect treasures). There are, however, many examples of each. The half-hearted attempts made to combine the two have, with a few honourable exceptions such as *Manic Miner* for the Spectrum, been poor. And the reason is that micros are short on memory, so all games will be limited until people buy discs. At present, carving a few kilobytes out of a text adventure, as has to be done to add pictures, is likely to cripple the game.

To attempt to overcome the memory pattern, Level 9 sticks to text adventures, which are produced on a specially-written development system (more about this later), and each takes up to six months to design and program. The main design stages are outlined below, to give an idea of what is involved and to help if you intend to produce your own adventures. We start off by choosing an adventure world.

Geography and History. Any adventure takes a long time to create, and should keep players busy for ages, so it must be set in an interesting and varied environment. An adventure on the Orient Express is unlikely to be successful as it would take place inside a string of near-identical carriages, whereas a treasure island adventure could include tropical reefs, caves, jungles and even a sailing ship – much more fun as long as you avoid too many corny 'Pieces of Eight' references. Science fiction books and fantasy games are good sources of ideas, disaster movies (which seem like adventures much of the time) are the worst source—they are *so* repetitive.

You also need a reason for the player arriving, near penniless, at the location of your choice. Shipwreck, prison escape, a long journey in search of hidden treasure, even the old standby of 'summoned by the Great One to undertake a secret mission' – all these are possible.

Outline maps. If all parts of your adventure world are much the same then I, for one, do not want to play it. Even a good thing gets boring if taken to excess. The world must be broken up into smaller sections, each with its own distinct characteristics, though the player can cross between these regions at will. I tend to break up a game into nine parts, so the treasure island example might give regions of: beach, caves, forest, mountain, lagoon and reefs, seagull cliffs, swamp, cannibal village and the anchored ship.

Draw a rough map of the adventure, showing these named areas, and pin it to a wall where you can see it easily. Then make a list of adventure ideas associated with each area, in rough, trying not to be too selective. There might be a comb on the beach, or a missionary in the cannibals' cooking pot, for example.

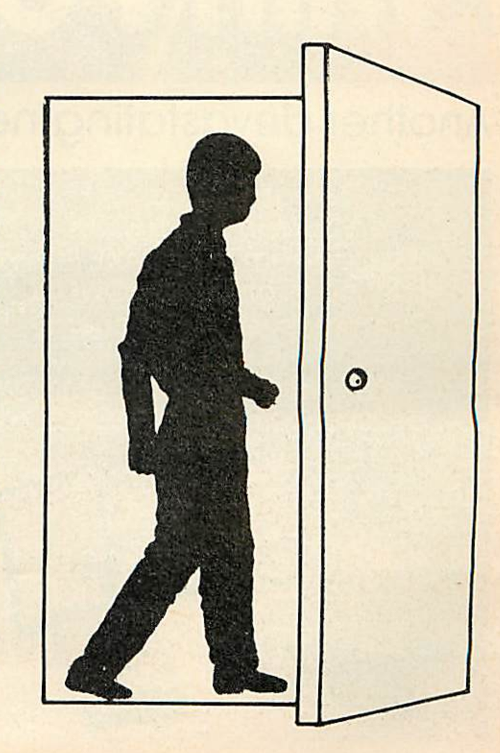
Detailed maps. A Level 9 adventure has more than 200 locations, so each area would have around 25 locations. Draw a detailed map of each area showing all the locations, with brief descriptions, and how the locations connect up. Below this, make brief notes about the puzzles relevant to that area. Then enlarge on the puzzles in the outline map. For example, maybe the comb from the beach is really a 'find-tooth comb' and will help locate discarded molars in the cannibal village. And perhaps these will be the teeth of the opposition (whoever they are) who will be grateful to receive their missing chompers and help you rescue the missionary.

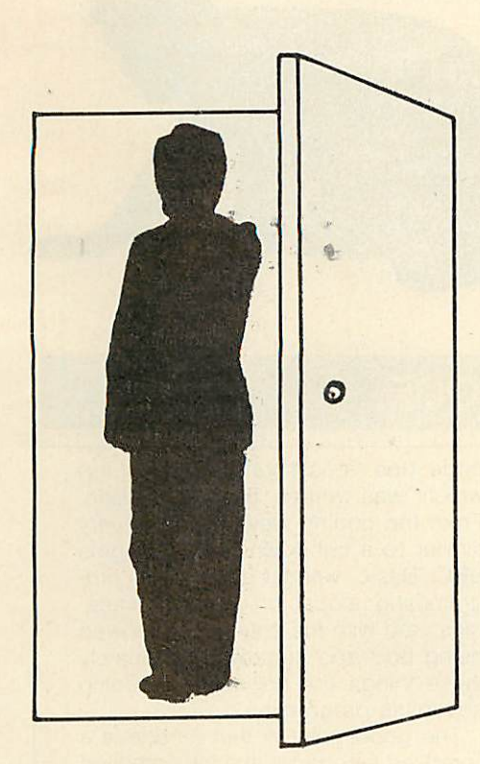
The idea is to end up with a set of neat maps, each with about 25 locations, and each with a list of puzzles and features. Show the starting position of all the objects on each map, too.

Play sequence. Write down what the player should do to solve the adventure in the quickest (or best) possible way. This helps you assess the game and make sure it can be completed. Mistakes are easy to make in a complex design, and this should help you sift them out.

Also, make a complete list of objects, with a brief description and notes for each one. To keep the game simple it is important that there is only one object with a given name: if the cannibals have a cooking pot then all other kinds of pot are not allowed. Watch out for trees, bottles, keys, tables and other common objects—it is easy to let more than one slip in.

Complete the design. Put the game on one side for a while, then return and assess it critically. What improvements can you make? Is one area short on puzzles? Is the forest just a boring maze of trees? Are





some of the puns just too awful? Can some puzzles be made trickier by disguising objects: for example, a fishing hook might be described as a bent pin to hide its true purpose. Are some chains of puzzles too long and involved (needing A to get B, and B to get C . . .)? Have you ensured that the first puzzles the player finds will be a bit easier than the rest? How many puzzles are similar? What do your friends think (if you've still got any after boring them for weeks)?

Make changes to rectify all faults and improve the game as much as you can — for now. Minor changes can still be added during coding (as well as providing the vital detail about what happens when the player does something wrong), but the design is complete when you finish this stage. Give yourself a pat on the back!

Allocate numbers. The design is now complete and you might think coding can start . . . but not quite. There is one important thing to do first, and that is to decide how to number the locations, and likewise how to put the objects into an order.

This is done to help keep the program small. Suppose half the objects are treasures . . . somewhere in the program you are bound to need to know whether the current object is valuable. If objects are given arbitrary numbers this is tricky – it either involves a lot of IFs or a new table – but if you order the objects to group the valuable ones together this test is much simpler. In the same way, consider grouping dark rooms, rooms near water, rooms near fire, rooms where wolves may attack, and so on, into adjacent sequences. This may save only a few hundred bytes, but it is definitely worthwhile.

Entering descriptions and exits. The next thing is to enter the information to get the adventure working. This covers the room and object descriptions, exit data and initial positions for objects. Once done, a simple program allows you to wander through the adventure world, looking at things, improving the scenery and generally tidying up before the bulk of programming starts.

At Level 9, we have a simple standard adventure program that we copy at this stage. It just handles movement – take, drop and a few other simple verbs – but it avoids wasting time (and means that these simple verbs work!).

When the adventure landscape looks OK, it's time for the real coding.

Writing the adventure. About 90% of the code of an adventure is there to handle the puzzles, special actions of objects, and the behaviour of the inhabitants of the game world. Unfortunately, there is no way of saving time here, and few general rules can be set down, as each game really should be unique. There are some essential points, however.

First, remember that most of the time the player will not do what you expect. Suppose you provide a spade. The player will not just dig to find the treasure under the 'disturbed mound of earth', but will also try digging in the flowerbeds, the middle of the road, and even on the sitting room carpet (if your adventure provides such a thing).

It is essential to try to cope with such behaviour (ensuring that the spade breaks eventually is a good idea). Simply responding 'You can't do that' to every unanticipated action is just not good enough.

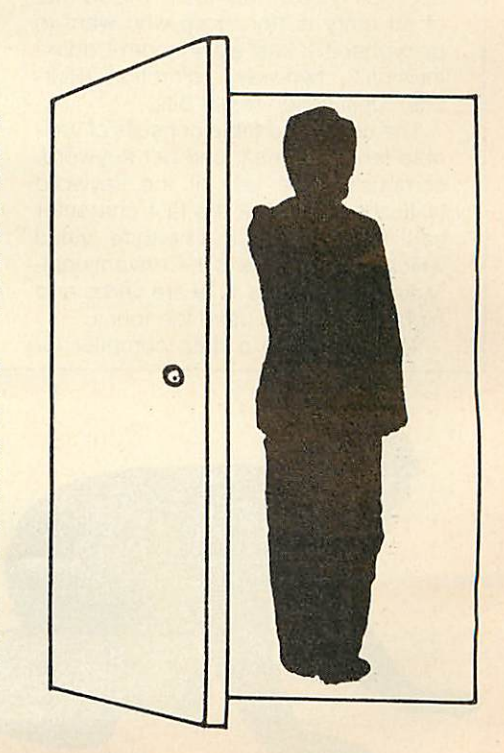
If possible, vary your error messages. In *Snowball* and *Lords of Time*, a technique which appeared on *Warp* is used. The message printed for common errors is varied (eg, when the program doesn't understand any of the input typed) and this seems to work well.

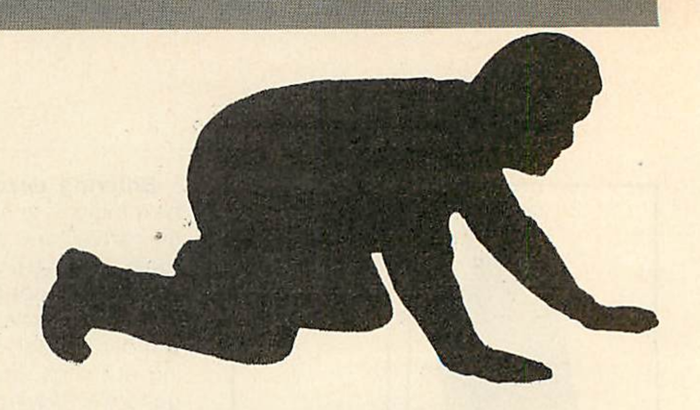
Next, don't kill the player without warning if you can avoid it (except, maybe, near the very end of the game). It's just as easy to say 'The liquid makes you really sick! It is disgusting!' as 'The liquid is deadly poison! It kills you!'

Finally, avoid too many mazes. Some people like them, most, apparently, do not.

Testing. It is essential to test the game, but it is *not* essential to fix every little bug. adventures are so complex that they are bound to have dozens or hundreds of bugs anyway and there is a danger that, in fixing something that no one will ever notice, you will cause real trouble. On the other hand, give copies of the game to your friends and ask for their reactions and comments. Fix all bugs that worry them, and consider making minor changes to the game if they find any part of the game too hard or too easy. And make sure you play right through the final version!

Finishing off. An adventure game must be accompanied by a good manual, introducing the game and giving an idea of what commands to use. You must also be prepared for hundreds of people asking for clues (this is actually quite valuable as you learn how people really tackle your games). Then it has to be marketed, and some of the hype and exaggeration has to be seen to be believed!





ALL IN THE GAME: Q-DOS, COMPASS AND A-CODE

THE Level 9 adventure development system currently runs on a heavily modified Nascom 2, a Z80-based micro with 64k of memory which can be switched between RAM and ROM. (The switches poke out of its case on little twisty wires!) The hardware is nothing special—though the ability to use a full 64k of RAM is vital—so we are seriously considering changing to the BBC micro's Z80 second processor, if and when this becomes readily available.

The software is the crafty part, and was all developed in-house. First, there's Q-DOS, the disc filing system. It's similar in scope to Acorn DFS but has more utilities for backup, recovery etc – and is very easy to 'get rid of' when we want the 4k of RAM it uses.

Next is Compass (Compression Assembler), which is used to enter exit and command table data for the adventures. It is easy to use and has the major advantage that it can be placed anywhere in memory, as can its source, code, symbol table etc. The exit table consists of two byte entries, at least one per room, in order of ascending room number. The format of an entry is (for those who want to decypher it!): Last exit in room?, door? invisible?, two-way?, direction (four-bits); destination (eight bits).

The command table consists of variable length entries, one per keyword, comprising the text of the keyword (with the top bit of the last character set) followed by a one-byte value which corresponds to it. Conventionally, keyword values 1-79 are verbs and higher values are used for nouns.

Then we have a data compiler for entry and compression of text messages. Such compression is absolutely vital as it allows us to squeeze in twice as much text – allowing greater realism in descriptions, greater variety in status and error messages and more scope for humour.

Text is entered via a simple full-screen editor, about which the less said the better, but at least it's free of bugs. Once entered, the messages are held in a simple list, separated by 01 characters, and can be modified or printed out as necessary.

Compression involves the program scanning the list, looking for the most common group of characters (perhaps 'the'). When found, this group is stored at the start of a second list and each occurrence in the original text is replaced by a single high-value byte. Obviously this replaces lots of groups of several characters by a single character each and so saves space. The program repeats the process a hundred or so times, replacing the most common group by a 127 character (perhaps), the next by 128 and so on. After quite a time (the program runs overnight) the text is halved in size.

Expansion of the message, when the adventure eventually runs, is simple. The appropriate message is copied to the screen, unless a character whose internal value is over 127 is found – whereupon the corresponding message from the list of 'most common letter groups' is printed out. This is the basis of the method used, but in fact we have a couple of other tricks to reduce text size a little bit more.

The adventure program itself is written in a specialised language called a-code (the 'a' is short for adventure) which was written by Mike Austin. From the coding viewpoint, it is very similar to a cut-down Basic (imagine BBC Basic without structured programming loops, only integer variables, and with the only maths allowed being add and subtract). Fortunately these things are not vital for coding adventure programs.

The good point is that a-code is a compiled language, and the compiled code is almost ten times smaller than the equivalent Basic, and it runs very much faster. The language includes built-in features tailored to adventure programs: analysing the player's input and returning keyword values; expanding messages automatically on printing; providing word-wrap to prevent words being split across the end of a line; and reporting exits from the current location. It naturally allows subroutine calls and my favourite feature is that an a-code program can clear the stack whenever this is convenient (this makes error recovery so much easier).

There is an a-code kernel for each micro for which we produce adventures – this is just about the only difference between the versions of an adventure for different micros.

We also have a weird and wonderful assortment of cables and short programs for use in copying adventures on to the target machines. The BBC is reasonably nice, but for the Atari we have to use both joystick ports to get the information, and the Oric 1 makes beeping noises as an adventure is slowly copied in via an edge connector. This all adds to the fun. ●



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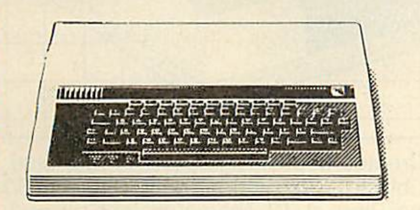


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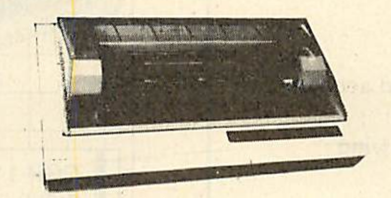
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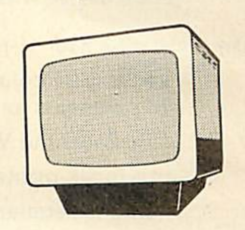
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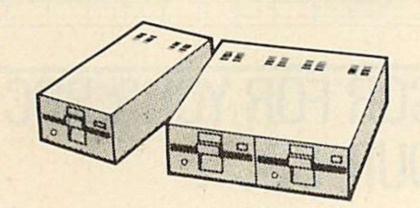
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CLIFFHANGER!

Peter Killworth's approach to creating an adventure game centres on finding a plot and building on it. Imagine, for example, the Unclimbable Cliff. . .

A GREAT deal of attention has been paid to the 'nuts and bolts' aspects of creating adventure games. But what really makes or breaks a game in the first place is the plot. A game can only become a 'classic' if it's fun to play, mystifying, and periodically gives the player that warm glow which comes from solving an exacting, but fairly set, puzzle, without a crib sheet. So I shall talk here about creating the plot for a game; and only a little about how to handle it in game terms. This is because the first rule of plot-building is to forget almost entirely about game mechanics! Figure out the plot in words, not Basic. Only when you've found something that holds together can you stop to ask if it's programmable.

So how do you go about creating one of those convoluted, multi-level puzzle sequences for an adventure? The easiest way to explain how I do it is by an example, to which much of this article will be devoted. I hope that by following my thoughts, you'll get an insight on how to make up puzzles—and use it in your own games.

I start off by thinking up a pair of 'concepts' which can interact. Each concept is usually for a single puzzle; although a theme suggested by other parts of a plot can equally suggest a concept. In this case, let's start with the first concept I ever thought up – the unclimbable cliff. (I remember programming it on a mainframe computer over several lunch hours, purely for my own amusement. I went home on a Friday evening, having mentioned its existence to just one person: on Monday morning, my message space was full of notes from people I'd never heard of, pointing out bugs in my mini-game!)

This first concept is illustrated in figures 1 and 2. The idea was of an unclimbable cliff-face with an unreachable cavern, high up, leading into the cliff. How was the player to reach it? He is provided with a long horizontal plank, several rooms long, just off the ground and parallel with it. By 'room' I mean a describable area, not necessarily a real room. The plank is easily accessible along its entire length from the ground, and can be walked upon. Near one end, as shown, is a pivot fixed to the cliff, on which the plank can theoretically rotate. On the other side of the pivot is a bucket with a fairly wide opening, but too narrow for the player to enter. Scattered around in fairly easy reach are several objects, each as heavy as the player: an old lead bath; a locked coffin; and so on.

To reach the cavern, the player had to climb onto the pivot with one of the heavy objects and drop it in the bucket. As you can imagine, this weight causes the whole affair to tilt over, as in Figure 2, with the plank now reaching seductively up to the cavern. All the player has to do, apparently, is to walk along and up the plank for several 'rooms' to the cavern entrance.

There's the original concept in full. I merely wanted to have a problem where the geometry of the game was drastically modified by the player's actions. Now, what can we do with the concept? Put another way, how can we make it difficult for the player?

First, does the idea stand up to the laws of physics? Well, no, not really! Remember that the weight in the bucket is about the player's weight. Simple balances for levers will convince you that once the player has walked more than one 'room' along the tilted plank, his weight should cause the plank to tilt back downwards, throwing the player into the air, with the sort of fatal consequences we've come to expect from games like these.

That's easy to handle. We allow the player to walk safely along the plank only the same number of steps as the number of heavy weights he has dropped in the bucket—so, in figure 2, three weights would be needed for the player to make it safely to the cavern. Obviously the player can carry only one weight at a time, which will make carting them around a bit of a pain; so a mental note is made not to leave them too far from the bucket. At least, not unless we can use one of them for another puzzle (a mental note of that as well). Also, climbing the plank while carrying a heavy weight should be fatal—the plank will break. The other thing we can do to worry the player is to make the plank break underneath him just as he gets to the cavern, thus preventing his return. There will be another way out, even if we haven't thought of it yet, but creating a little honest worry in the player's mind never does any harm!

On the face of it, we've exhausted the concept of the plank and pivot. They're still really a single puzzle ('How do I get up there? I do such-and-such, and then I get up there'). Convoluted puzzles – the kind that take days to solve rather than minutes – usually involve other puzzles or concepts. So let's consider what the player might find when he gets into the cavern.

Obviously we must confront him with a problem which will need some object, objects, or information which he should have brought from below. Let's make a simple one. The cavern is a corridor leading into the cliff, ending in a huge sheet of glass as in figure 3. (Ignore the alcove for a moment, we haven't thought of that yet.) Beyond the glass, fish are swimming. That will plant the idea of water in the player's head. (Alfred Hitchcock said that for maximum audience enjoyment, they should be provided with all the information beforehand.) For the fun of it, let's put a large plug with a handle right in the middle of the glass. So that can be the second problem—how is the player to get past the glass?

Now put yourself in the player's place. After saving his position, the player will obviously try 'break glass' or 'pull plug' or 'push plug'. Equally obviously he'll get drowned as the glass breaks and the water pours out over him. He'll need a tool to survive: a diving suit, preferably an ancient one, as we'll see. We can require that the suit is actually *worn* when he pulls the plug so as not to drown.

No, that puzzle's too simple. Surely the force of the water should swoosh him out through the corridor and over the cliff, with obvious results? Now that would be rather good. Our player finds out the hard way that breaking the glass drowns him; he realises that the old diving suit he saw earlier would be useful; carries it up the plank and wears it, tries again, and dies a different way! Excellent. If we can only make it more difficult to get the suit up to the cavern in the first place, he'll be even more certain he has the solution. (Have you noticed that *we* don't have a solution yet?)

So we must stop him carrying the suit up the plank. How? A slippery patch between the second and third 'rooms' on the plank will do fine. If he wasn't carrying the suit, we warn him that he nearly fell over, it was so slippery. If he was, he's too clumsy and he falls off. Should he try throwing the suit past the slippery patch, we can make it fall to the ground, thus thwarting him.

The astute player will wear his suit and climb, thus avoiding the clumsiness problem. We should applaud such astuteness, and allow him to do this, while stopping him another way. If the suit is old, it won't have much oxygen left, will it? Each 'beat' the player wears it uses up one notch of oxygen, of course. If we arrange the solution to the glass so it needs all but one notch of the suit's oxygen, then walking up in the suit will use up a minimum of two notches (one to wear it, one to walk past the slippery area). Better and better! The player may take some time to find out he's wrong on that one. The longer we can make him convinced he has the solution, the more frustrated he'll be when he finds out he hasn't and the more he'll appreciate his efforts when he finds the real solution.

By the way, notice I said that the 'correct' solution will need all but one of the notches of oxygen. That's my prejudice showing through. Adventure games are a test of skill, yes, but of absolute precision, no. Let's give him a small margin of error—but not a large one.

So how *does* the player get the wretched suit up to the cavern, and what does he do with it there? Why can't we use the motion of the plank? If he leaves the suit on the end of the plank nearest the cavern and then drops a weight into the bucket, it'll be waiting for him when he gets up there. Oh, no, that won't do, because we were going to have the plank break just as he reached the end, and we don't want to give him a game-turn to pick something up, do we? So instead, we can have the suit thrown upwards by the plank and land on the ledge, as in figure 4. A fine solution, but the player will never think of it! So how can we suggest it to him?

This brings up the aspect of fairness to players. If a solution is in any way unlikely, or difficult to think of, then the player has to get a clue. Now presumably he'll have messed around with that plank tilting long before he gets to the stage of worrying about the suit. So when the plank tilts over, we can add a message about 'particles of rubble on the end of the plank shoot up and land on the ledge', modifying the message if there were any objects on the end of the plank. This will plant a clue, but well before it can be used. (Another rule: give clues, yes, but it's fair to give them when they aren't useful yet.)

Now both the suit and the player are up in the corridor. How can the player break the glass and survive? If he could only be out of the way of the water's rush when it came, he could survive. So clearly he needs to be a little distance from the plug or glass when it breaks. Hence the corridor structure: if he can break the glass from one room away, he has every reason to hope for survival. He won't succeed, of course . . . To pull the plug from some way away, we must supply a coil of rope somewhere, and let him 'Tie rope' to the plug. He can then back away, keeping hold of the rope (mental note: that'll be interesting to program!), put the suit on, and try 'Pull rope'. The plug will come off, breaking the glass, and the water will pour out, filling up the area in front of the glass. If our player stands there stupidly, the water gets him *next* turn instead of the one when the glass broke—but not quite with the same results.

There's another important point about puzzles here. The player is now very near the solution, as we'll see. It is *vital* that he

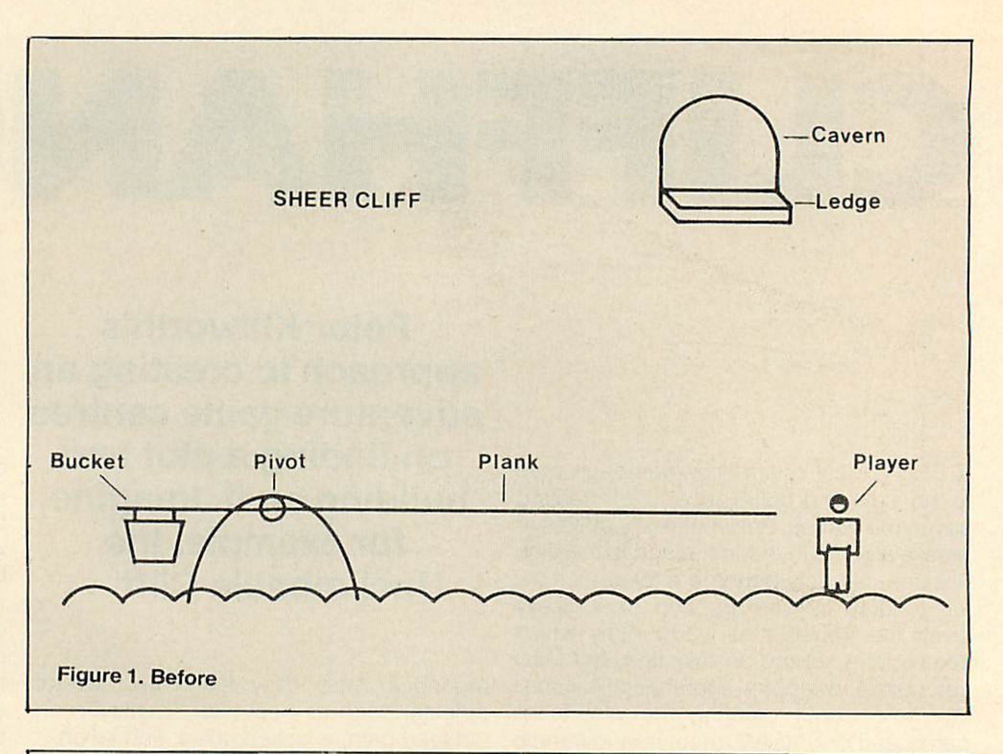
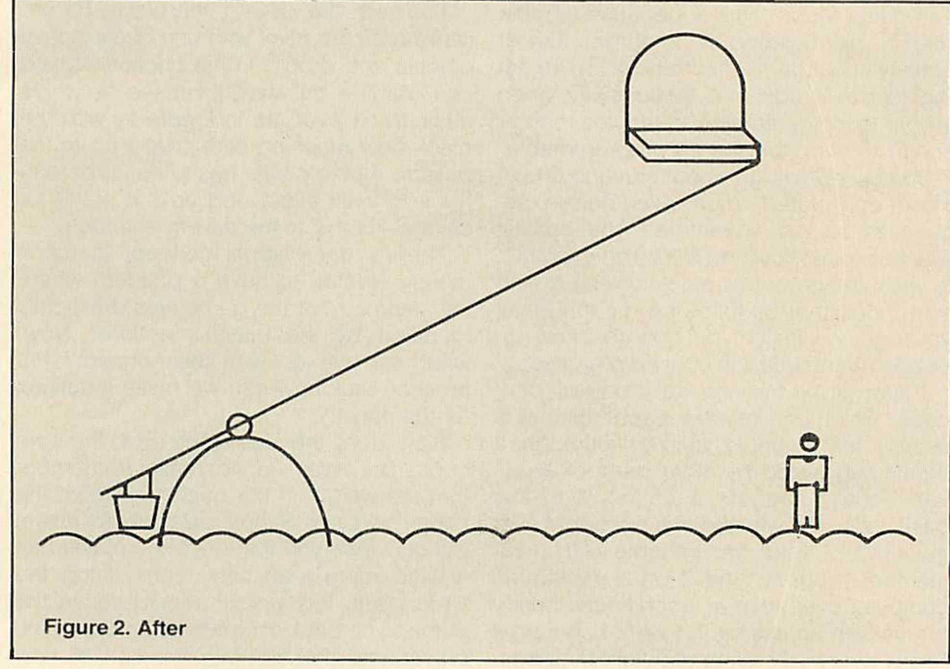


Figure 1. Before


Figure 2. After

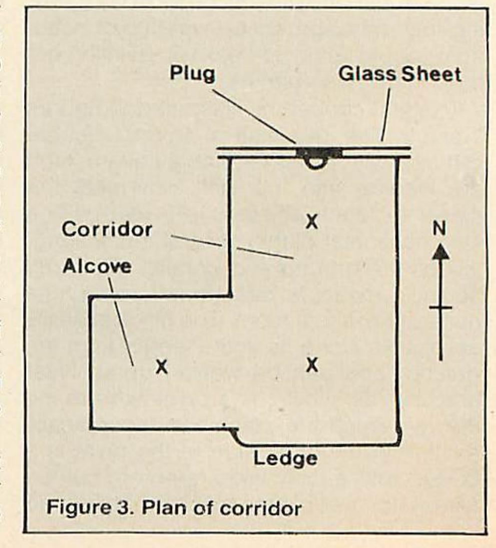


Figure 3. Plan of corridor

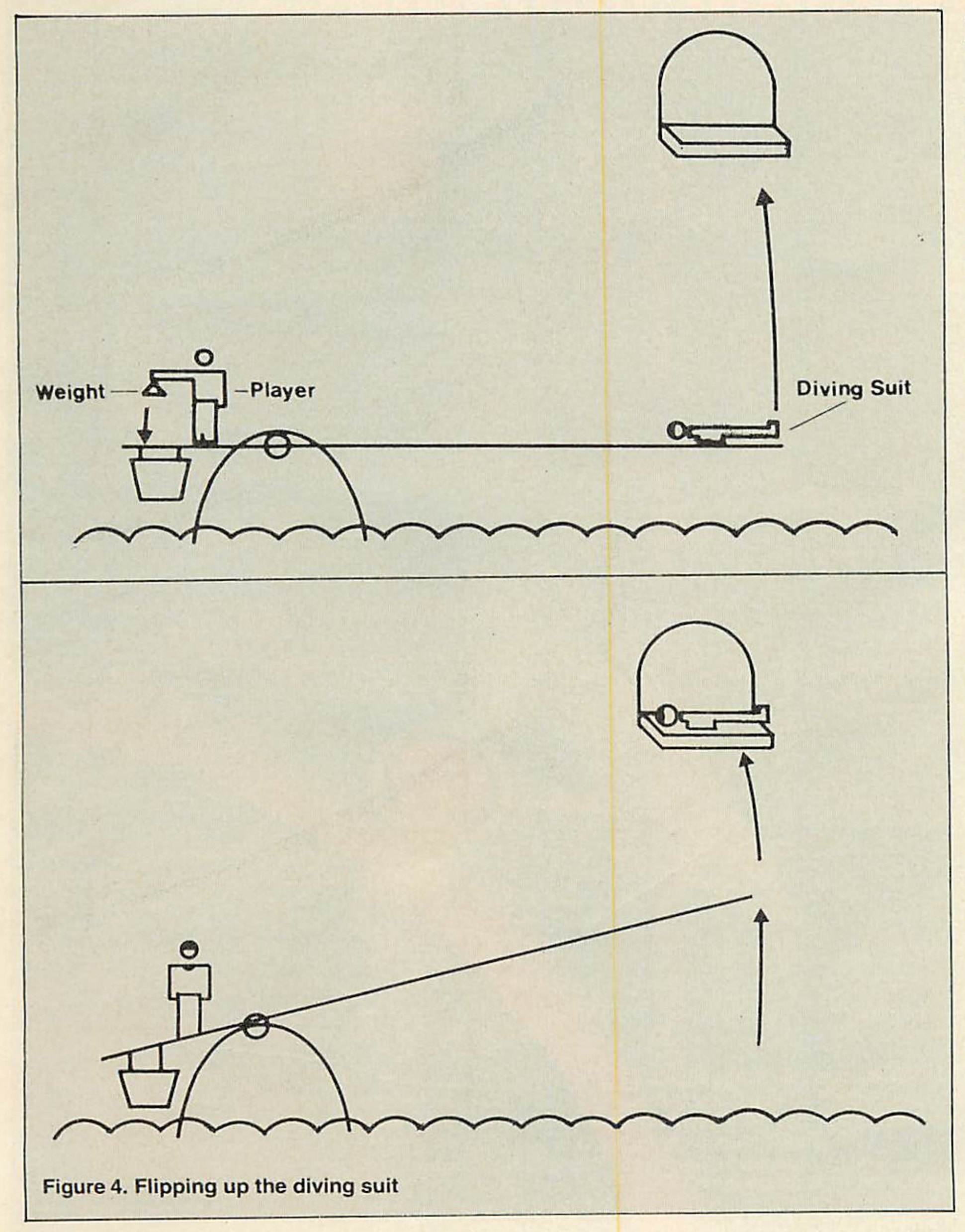


Figure 4. Flipping up the diving suit

be told this, or else he'll never find the real solution. So when the water hits him, he should get a very different message from what happened before. Something like 'The force of the water has much decreased, but you're still swept out and over the cliff.' He has to realise that he's nearly correct.

The solution should now be obvious. He can't back away any further, because the geometry won't let him (ie, the corridor hasn't any more rooms). But he can dodge sideways, into the alcove! So now he tries this, with 'Pull rope' ('The glass breaks, and water begins to pour . . .') followed by 'West', or whatever, to get into the alcove, which gets a 'Just in time, too!' The water swooshes past the end of the alcove, carrying rope, plug and everything in its path over the cliff. After a while, the waters die away.

Did you notice how we avoided handling the awkward object consisting of a rope with a plug tied on the end? This cleaning-up operation is easy to program and saves us much labour.

Now, how many notches of oxygen does that take? 'Wear suit' is one; 'Pull rope' is another; 'West' is a third. One more for kindness is four notches of oxygen which we must suppy—after that he starts choking, and must drop the suit. So as we surmised, if he wears the suit on the way up, he'll run out of oxygen too soon to solve the problem!

That completes the multi-level puzzle associated directly with the interaction of the two concepts: the tilting plank and the glass tank. However, there's a whole lot more we can do with what we have, both before and after the set-piece itself. This is where some of the other techniques in plot-writing come in, and I'll discuss some of these briefly within the framework we've developed so far.

First, we can seek to use objects in unfamiliar ways. The two objects in the game (suit and rope), plus the heavy weights, have all been used 'normally': you would expect to wear a diving suit, tie a rope, and so on. Can we add to the player's enjoyment by using some of these differently? For example, what of the weights? Suppose we protected the diving suit against discovery by having a large scorpion run out and sting you when you tried to take the suit originally? We could allow the player one game-turn to avoid the threat. This is rather a nice puzzle, as the obvious solution (put the suit on to protect your skin) will not be allowed (the scorpion gets you anyway), and second it wouldn't work as it would *waste oxygen. If* the player tries throwing some object, it can 'bounce off the scorpion's scaly hide'. This again is a non-null response from the game which signals to the player that he's on the right track; what he should have tried is throwing (or dropping, if we feel kind) one of the heavy objects. 'There is a sickening squelch, and a foul odour of squashed scorpion . . .'

On the same lines, can we re-use the suit? How about having a door some way beyond the glass area marked 'Ogre – do not disturb', and a pair of glasses hanging high up by the door. The door is unopenable, but 'Knock' produces an irritable ogre who peers out short-sightedly, grabs his glasses and puts them on, mutters 'Oh, there you are!' and eats the player. The solution, to tell you that first this time, is to jump up and grab the glasses (the noise from which brings the ogre anyway). But provided the player has left the suit standing up in the room, when the ogre enters he can't find his glasses, so stares around until he sees the suit. Being short-sighted, he assumes it's the player and grabs it and eats it, while the player slips past him. Again, we *must* signal this when the player's near the solution. So if he's tried taking the glasses, but hasn't left the suit on the floor, we provide text like 'The ogre peers around until he sees a man-sized object – you!' Or perhaps something a little less blatant; it depends how kind you're feeling!

This puzzle is also an example of another key feature of adventure games: the interaction with other beings. Nothing is worse than a lifeless game in which the player meets nothing but objects and words. 'People' make a game much more friendly. They don't have to exist as actual objects in the game—the ogre is a good example. He's a subprogram, although a good game will ensure that the word 'ogre' is understood.

Another, unfortunately rather rare, problem is one where there is apparently no problem! An example of this could involve one of those heavy weights. Suppose, as is often common in adventure games, we made moving from a dark area to a dark area without a light source fatal. If we also disallowed carrying anything else while carrying one of the heavy weights, and put a weight inside a dark region, how is the player to get it to the bucket? There's no problem, you see, until the player tries doing something. (The solution is trivial: drop the lamp one move towards light from the heavy weight; move to weight, which is from a lit area and therefore safe; pick up

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weight; carry it past the lamp one move, which is also safe; drop the weight; get the lamp and *leap-frog it* past the weight one move; drop the lamp; etc, until daylight is reached.)

Another example of the same type could be a *maze*, about which a whole article could be written. Now most mazes are merely a collection of contiguous areas, all of which have the same room description. We all know the sinking feeling of 'You are in a collection of twisty little passages, all the same'! *However, a maze* can be much more interesting, especially if it isn't obviously a maze at all. You might have an area with some suitable suggestive room description, but which seems to do nothing at all; it's merely a room. But manipulation of *an object* in the game, say, will cause some extra reaction which will enable the player to trace through a tortuous path to reach some goal. A 'trivial' solution to the maze can be organised (eg, meeting a fellow-traveller with droopy trousers who tells you the exit) which isn't really the solution; had you had a piece of string, to hold up his trousers, he'd have given you extra information. Or something of the kind, anyway. Why not have a maze which can't be mapped the usual way—by dropping objects—because for some reason the objects don't stay put. Concocting such mazes is one of my delights in programming, I must confess.

One can also set 'explicit puzzles'. For example, a piece of code written on a wall, which must be deciphered before the player can make use of the information it contains. Since not all players are expert cryptanalysts, there must be a collection of equally cryptic hints which will enable the player to decipher the code. Walls are very useful here; graffiti writers have a field day in adventure games. By scattering the hints suitably, it may take the player a long time to figure the solution out. In cases like that, placing the code near the player's starting area adds to the puzzlement.

Two other sources of puzzles are mathematics and thematic problems. The former can be disguised, and yet based firmly on some well-known problem, theorem, or whatever. With a little thought I suspect even Pythagoras' theorem could be made into a puzzle. (Now there's an idea! Suppose the rope was five rooms long, however that's measured, but we have to pull it around two sides of a right-angled triangle, sides three and four rooms. Yes, there might be something there . . .) Thematic ideas often provide the smaller, 'filling-in' problems which are essential for adventures. After all, not every puzzle should be earth-shatteringly difficult, or our player will never get anywhere! So a few of the 'you can't do this until you've done this action' puzzles, which stand alone, are important, and can often be added while the main plot is being written down in legible form for the first time. That rope, for example – can we make it a little harder to get? It could be holding up a rotting corpse on a gallows, perhaps. But the stench of the corpse drives the player back. One might require 'Hold breath' as a solution, or an approach from another direction to avoid the prevailing wind! The point is the problem stands alone, involving no other objects or problems, and it isn't too difficult.

No article of this type would really be complete without at least a few words about how one might program these ideas. I suspect many readers have been thinking 'All very well for him, but *I* couldn't program that pivot!'

In many ways the programming is quite straightforward, if you have a clean, efficient database system and an overall running program as a model before you. The running program I use consists of:

- a between-turns section. This covers a room description, if required, plus any other housework the individual game may require;
- command input and checking;

“ Steal ideas from this article, stories, books, maths texts, anywhere ”

- a pre-programming phase, consisting of a program which is obeyed before the command is actually executed. The scorpion would be handled here, for example, killing the player before his command was acted upon unless it was 'Throw x', where 'x' is one of the heavy objects;
- command handling, in which the instructions from the player are finally obeyed;
- a post-programming phase, consisting of a program obeyed only after the player's command has been executed. It would be here that we counted oxygen usage in that diving suit, for example.

This sequence isn't original, and there are others which would do as well or better. The point is that by building in such flexibility at the beginning, programming any specific game is a lot easier than having to think through a different sequence every game.

The other feature I mentioned is an efficient database system. Most systems you read about in articles on programming games use a single room to store the articles a player is carrying. For many purposes this is fine; but what if the player is carrying a rucksack which contains a bottle which contains a genie and a sealed letter? Hence, even though I may not need it for any individual game, my database allows chains of objects. This avoids any worry when faced with some new complication.

Yes, but how about the pivot problem? In that case I would let each of the rooms on the ground and each of the rooms on the plank be in one of two 'states'. In state zero, say, the plank is flat, and can be reached from ground rooms. In state one, the plank is tilted, and can no longer be reached from the ground. The result of trying to move will then depend on the state of the room the player is in; if zero, a move from ground to plank is possible; if unity, it isn't possible. The handling of this would be done by an exit program—fortunately the same one for many exits—tacked onto the exit from ground to plank.

The descriptions of the plank area are handled by a message-swapping system. Each room has a pointer stored with it which accesses the room description message. This pointer is never altered, though you could if you wanted to, and in some systems the pointer would be changed frequently. However, the message to which the pointer points is a null message (ie prints nothing) but is switched automatically by the message system to one of a set of possible messages.

Which message is switched to depends – again automatically – on the state of the room being described.

This may sound complicated. Yes, it is if you're setting something like this up from scratch. But, and I repeat, if you have a flexible system to start with, then handling something like the pivot is straightforward. You simply write a pair of messages for each area; the first refers to a flat plank, the second to a tilted plank. These are linked by the null message I mentioned; and that's the end of that bit of programming. To be sure, you will still have to write program and text for the time when the plank tilts up; but actually tilting the plank involves nothing more than resetting the state of each of the rooms affected.

The details of such a system are of course beyond the scope of this article, and I mention the system merely to prove that the wild ideas I've been writing about are distinctly programmable. (If you don't believe me, there are many players of a game called *Brand X* who can confirm that it has been programmed, although with a vastly different plot!)

So please—don't decide on your plot because of the limitations you think you may have in being able to program it. Instead, let your mind range freely; steal ideas from this article, stories, books, maths texts, anywhere. The better the ideas the better your games will be – and, most important of all, *the more enjoyment you will give to your players.* ●

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Jonathan Griffiths translates the ideas of the adventure games writer into computer language

TWO main methods are currently used to write an adventure game. One is by writing the program containing the game logic and the database that supplies the text and vocabulary side-by-side, and the other is to write a general-purpose program that relies totally on the database to supply the game.

The first method is by far the commonest, although – as I hope to show – that does not necessarily mean the best. As an example of the first type I've chosen *Colossal Cave*, a very large early adventure. In this all the events that occur, such as creating a crystal bridge with the wave of a wand, and having all your treasure stolen by a marauding pirate, are 'hand coded', by which I mean that the program would typically have lines such as:

```
IF RND(40)=1 THEN PROCpirate
```

and

```
IF input$="WAVE WAND" THEN PROCcreate(bridge)
```

and so on.

This is easy to understand and is a fairly obvious way to start. However, once you have written an adventure in this manner it becomes apparent that to write another adventure you must start from scratch again. The alternative is to use an adventure language, with built-in primitives specifically tailored for the adventure writer that would normally handle such things as testing to see if the lamp is on before allowing you to see the contents of the room.

In this one would have, for example:

```
DEFINE pirate
  pirateobj = playerobj
  MESS "The pirate steals your treasure and runs away"
END
```

to allow the pirate to steal your treasure.

Note the line 'pirateobj = playerobj' to transfer all the player's objects to the pirate. It is features like these that make adventure languages popular among those who write more than one adventure. Gone is all the endless fiddling with implementing your own list-handling routines and wondering whether some horrible bug might still be lurking there when you've finished.

In any adventure the player is surrounded by a series of rooms with objects in them. If you pare the adventure down it becomes quite easy to visualise a language for manipulating it. The first thing needed is a method for storing rooms (a 'room' might be any place where one can stay – even if it's an open field). Various other things have to be stored: first, the message to be printed out when the player enters the room (ie, the room description), any objects that might be in the room (only one object has to be noted – see later) and also the directions that one can take to leave the room, coupled with the numbers of the rooms that those directions take you to. Given this structure, it is now possible to start in a room and to progress to the other rooms in the adventure, provided they are connected.

Next, you need to store the objects and people that inhabit the adventure. One can think of people as objects with extra properties, and if one follows this to its natural conclusion the player also becomes an object.

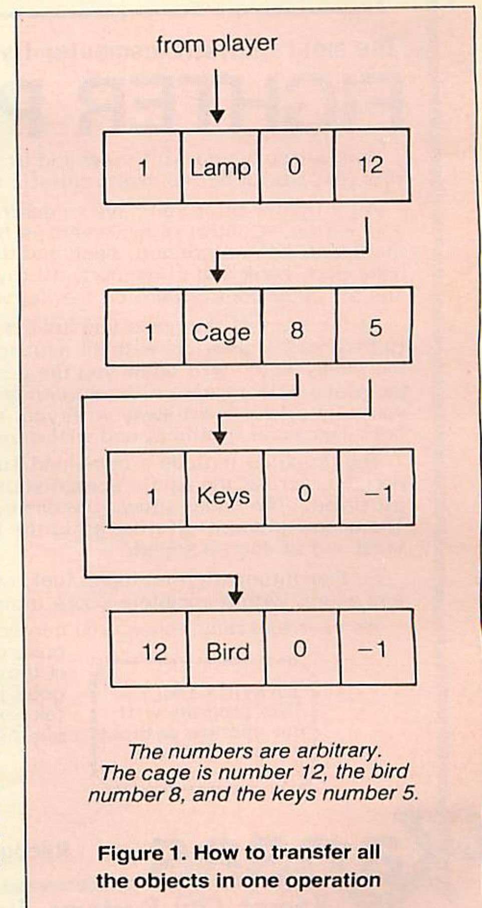
A description of the object (brass lamp, large rabbit, etc) needs to be stored, any special properties that it possesses, and which, if any, objects are associated with it. Thus the player starts off with no associated objects, but soon accumulates them. This 'object holding object' mechanism is usually done by using linked lists in which each element (in this case an object) has a pointer to the next element in the list, with some form of terminator to indicate the end of the list. To move all objects from one person to another you simply move the first element in the list to the other person; all the other objects will be 'hanging off' the first one, and thus the lot of objects is transferred in one operation.

A typical list is shown in figure 1. Each element in the list has three pointers: one indicating who owns it, a 'down pointer' indicating whether that object owns something (0 if nothing is held by that object), and the other to say where to go next (at the end of each box). Thus the lamp, cage and keys are all in the player's possession (object 1 is the player), and the bird is in the cage's possession and thus indirectly in the player's possession. To move all the objects from the cage onwards the lamp must replace the '12' with a '−1' (in order to signify 'end of list'), and the thing (location or object) that wishes to take the objects must have a '12' at the end of its list. You have to go through the new list replacing all '1's' in the 'owner' information with the new owner (the bird will still be in the cage).

This structure is tree-like and can thus be accessed quite easily. Astute readers will notice, however, that all the above information can be packed into just two pointers per element by combining the down-pointer with the next-element pointer.

From this one can see that there are two distinct areas of the database, the static (ie, unchangeable) and the dynamic (ie, variable). This allows the player to restart the adventure by re-loading the dynamic section (the object information). The game can be saved by merely saving the dynamic section.

Other fundamentals include words and messages. Messages are simply the textual descriptions (usually compressed – see later) of the rooms and objects, and the various events that occur in the game. Thus a location description routine would print out the message associated with the player's location, plus the message describing all objects therein. Such a routine would know about light and dark and, for example, invisibility properties of objects.



The numbers are arbitrary. The cage is number 12, the bird number 8, and the keys number 5.

Figure 1. How to transfer all the objects in one operation

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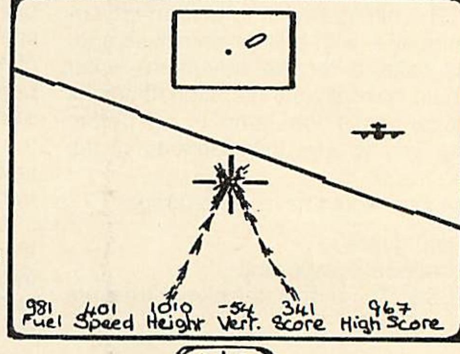
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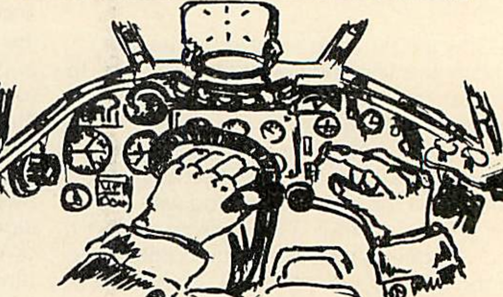
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At the start of the game you have a view of the runway and it is up to you to take your fighter off without mishap. As you climb away, you switch on the radar, which will show you the position of the enemy. As you get closer the plane will appear on the screen and then it is up to you to get it in your sights and blast away with your air-to-air missile. Certain enemy planes have kamakazi instincts and will dive at your cities, then you are in trouble!

The graphics include a combined Turn and Bank indicator and Artificial Horizon, across the whole screen showing the actual state of your flying at all times. The Radar shows the enemy position in relationship to yourself. The enemy plane is lifelike as is the firing and explosions. Colour is used and of course sound.

Further information includes fuel, speed, altitude, rate of climb/decent and score, with a complete score table as well.



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Messages often have special properties, such as allowing the substitution of words (which can include phrases) or numbers (for such things as scores), or indeed other messages. The database writer is then able, say, to have changing messages on walls or to devise similar messages that share identical text.

Words are the items that the adventure recognises from the player. These also have several properties – they can be abbreviable, begin with a vowel (which dictates whether you put 'a' or 'an' before it), be singular or plural, and so on. They also have meanings – in many cases more than one, so for example 'paint' may be both a verb and an object, and 'treasure' might refer to every valuable object in the game.

To follow on from this rather bare structure one needs to give the adventure some rules. An obvious one is not to allow the player to see anything in a dark room if he has no lamp. This is normally done by having (in the properties of the location) a flag saying whether or not there is ambient light. If there is no normal light the routine must look through all the objects in the room (including the player's) to see if any of them are casting light. If an object can be seen the routine should print the description.

Locations and directions need special routines so that you can prevent the player going through the fiery passages unless he/she has water. Thus every exit from each location has an optional 'trap' in it to prevent the player wandering around without having solved the puzzles.

When handling directions it is useful to have a word associated with each direction, so that when the player attempts to go in an illegal direction the adventure can say:

You cannot go north from here

even if the player just typed 'GO N'. This can be considered irrelevant on smalll adventures, as the message:

You cannot go in that direction

will cover all eventualities, but it doesn't look as good. The difference between an enjoyable adventure and a boring one may simply be in the way that the messages are printed out.

I have mentioned routines without really describing how they would work. A routine should be able to access any section of the database via the standard core of the program, which will contain such built-in functions as 'Return the start of the object list for the player' (for inventories, etc), 'Return the location that the player is in' (for messages, direction information, etc), 'Return a random number in a given range' and so on.

The routines are all fairly low-level – they perform simple operations. This means that they have maximum flexibility, but it also puts the onus on the database writer to make sure that, for example, the crystal bridge cannot be invoked without the wand, as the adventure playing program won't be able to tell the difference between a wand and a vase of petunias.

Ensuring that the output is grammatical means printing out the strings correctly, for example, saying 'Some keys are here' rather than 'A keys is here'. This can require some fairly fancy code to handle – the above case is relatively simple, as the word 'keys' would be flagged as plural in its property information, and thus the printing routine would substitute 'are' for 'is', and 'Some' for 'A'. However, things can get a lot more complex, as in 'The dwarf takes his axe' and 'The dwarves take their axes', which should be capable of being synthesised from the same basic text.

Allowing textual input in abbreviated form is an easy way of making the adventure more enjoyable for the player. Take the first character that has been input and match it against the first string that contains the same first character. Now take the second character (if there is one) and match the first two characters against the vocabulary list, and so on until a word terminator is reached (either a space or a carriage return, or possibly a full stop or other punctuation), and take the match found so far as the word to be used.

The problem with this approach is that the player must know the full list of vocabulary and the order in which it will be checked before any abbreviation can be reliably predicted; for example, if one used the phrase 'Take bott' meaning 'Take bottle', the program might also know about a 'bottom' and the abbreviation 'bott' might be checked against 'bottom' first, and thus the program would probably respond with:

'Bottom of what?'

which would confuse the player.

Another method commonly employed in adventures is to look at only the first *n* characters, where *n* is usually 4, although this would mean that one couldn't have any words with the first four letters the same (as in our previous example), as the player would not be able to distinguish between them. You might also allow abbreviations only where the word is deemed to have no other possible connotations, so that 'inventory' can be abbreviated (because not many other words look like it in an adventure), but 'go' cannot, as other words such as 'get' would share the abbreviation.

The other approach is to let the player type in multi-command lines, such as:

'Take the gold and go north'

which would simply require the adventure to process the line as far as the 'and', and then take the rest of the line from the 'and' as the next input and process that, then get another line from the player. Another example might be:

'Take the gold and silver'

This would be slightly more difficult to handle, although the first bit would be the same (take everything up to the 'and' as the first command). The second bit would have to say something like: 'Substitute the object after the 'and' for the object before the 'and', and then process'. This could be extended to more than two objects fairly easily.

Where things get really hairy is if you start to handle sentences such as:

'Take everything but the lamp'

which requires the routine to know all the objects in the room, take them continually until the room is empty, and to avoid taking the object (or objects) specified.

You might even allow the player to give objects other names, such as calling his lamp a lantern, so that he feels more at ease when playing. This facility could be extended to making the player name something that previously had no name, so that the game would ask the player to supply a name for the lump of green putty that follows him around. This has obvious uses in D & D type scenarios (Dungeons & Dragons, a role-playing game) for naming the members of a party.

In any large adventure text usually accounts for the greatest area of memory, and so one of the best ways to get more text – and thus more game – out of the same amount of memory is to compress the text. There are several methods of doing this. The first involves digrams and/or trigrams. In these you work out the most common letter pairs and triplets (for digrams and trigrams respectively), and prepare your text. Next, a program is written which takes the text and, wherever it sees a letter pair that is in its digram table, substitutes a special code for that letter pair (in most adventures the ASCII codes from 0 to 31 and from 128 to 255 are not used, and so may be used as the codes for the digrams). Using this method, approximately 30 per cent of memory capacity may be saved.

Other methods are to do the same as BBC Basic and have codes for whole words (or even phrases), and then to follow the above procedure; or use Huffman coding which, while a bit more difficult, often gives even better savings. In this, you work out the number of times that any one character appears in the text and assign a bit-pattern to it (shortest bit-pattern for the most common characters, such as 'e' and 'a', and longest bit-pattern for the uncommon ones, such as 'q' and 'z'). Now the text is converted into these bit-patterns. For example:

Character	Bit-pattern
'e'	10
'a'	01
's'	111
't'	0001

I am much indebted to Jon Thackray and David Seal of Acorn for their help in the preparation of this article. **JG**

ROMS

SOFTWARE FOR THE BBC MICRO

```
WORDWISE
(C) Computer Concepts 1982

1) Save entire text
2) Load new text
3) Save marked text
4) Load text to cursor
5) Search and Replace
6) Print text
7) Preview text
8) Spool text

ESC Edit Mode

Please enter choice_
```

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GREMLIN 32K

```
  A=57    X=00    Y=00
S =01FF 89 10 E3 DA 92 93 DC 89
PC=8213 78 A9 DA 8D 02 02 A9 92 x
        SEI
   7FF0 20 20 20 20 20 20 20 20
   7FF8 20 20 20 20 20 20 20 20
M =8000 4C 13 82 4C 30 80 C2 15 L  Lo
   8008 A8 47 52 45 4D 4C 49 4E .GREMLIN
   8010 00 38 2E 33 32 00 28 43 .8.32 (C
   8018 29 31 39 38 33 20 43 6F )1983 Co
--------------------------------------

*LVAR
START 9000
FRED 6
END 8100
JIM 5
!
!PRINT FRED+JIM
0B
!
!
```

The GREMLIN system is a powerful de-bugging tool for 6502 machine-code programs. It includes all the usual features found in good machine-code monitors, such as memory search, intelligent memory move routines, memory editors etc. These work at byte, word or string level. A built in help menu can also be displayed at any time.

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```
DISC DOCTOR 1.09
  DIS <<sta>> <<end>> <<ofs>>
  DISCTAPE <afsp> <<afsp>>...
  DOWNLOAD <fsp> <<adr>>
  DSEARCH <str> <trk> <<trk><sct><drv>>
  DZAP <<trk>> <<trk><sct><drv>>
  EDIT <<key no.>>
  FIND <str>
  FORM <drv> <no. trks> <<stt>> <<S>>
  JOIN <fsp> <afsp> <<afsp>>...
  MENU <<drv>>
  MOVE <<dest page>> <<src page>>
  MSEARCH <str> <<adr>>
  MZAP <<adr>>
  PARTLOAD <fsp> <ofs> <ext> <adr>
  RECOVER <trk> <sct> <sct> <adr> <drv>
  RESTORE <trk> <sct> <sct> <adr> <drv>
  SHIFT <src> <dest> <ext>
  SWAP <<drv>>
  TAPEDISC <<fsp>>...
  VERIFY <<drv>> <<no. trks>> <<stt>>
```

DISC DOCTOR 32K

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```
TERMI - BBC TERMINAL PROGRAM RELEASE 2.0
        FROM COMPUTER CONCEPTS
   (C)  D.J.Martin and M.Miles  1983
------- Function key definitions -------
Key --- Key use ---  Key with  Key with
No.                  SHIFT     CONTROL
f0  Printer          Start     Stop
f1  Change Mode      80 char   40 char
f2  Spooler          Start     Stop
f3  Transmit file    Start     Abort
f4  Transmit file    Pause     Continue
f5  Emulate          Custom    BBC
f6  Set handshake    XON/XOFF  None
f7  Special funct'n  OSCLI     Set Mask
f8  Special Options  Full/Half Parity
f9  Reset            Soft      Hard
      SHIFT/CONTROL FUNCTION KEYS
f0  Print Screen.
f1  Mode 7.
f9  Reset XMIT block.
```

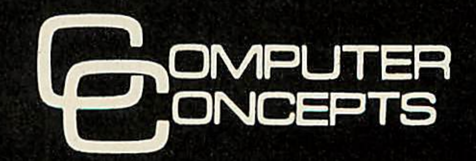
TERMI 32K

This program enables the BBC machine to act as an advanced terminal when connected to another computer or to a modem via the RS-423 (RS-232) interface. This provides facilities to transmit data from disc and the spooling of data from the 'line' to the disc or printer.

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THE SQUEEZE IS ON

Peter Voke reveals the tricks of tightening up adventure text

YOU MAY hear many criticisms of adventure games for the BBC micro, Atom or Electron – perhaps for lack of imagination or originality, or for the idiotic sense of humour – but one thing must be admitted: you almost always get a lot of game for your money. Adventures with 100, even 200 or more locations are available for the 32k BBC micro. There are even versions of the original mainframe adventure, which was written in Fortran and occupied much of a large mainframe's memory core after it was compiled. One adventure software company even sells a version for the BBC micro with 70 extra rooms added.

How do they do it? If you ever sit down to plan an adventure program, or attempt to write one, you will appreciate just what the professional adventure creators have achieved. First there has to be a section of program that takes the player's input and analyses it. Then there have to be tables of all the input words the computer must recognise such as north, take, drop, sword, or box. Then there must be sections of the program dealing with the computer's responses to all the things the player can dream up: moving about from one location to another, picking up objects and dropping them, opening doors, killing trolls, and so on. A good adventure will also cope with the less conventional player who tries to swallow the sword or use it to hack through doors!

Even with all this achieved, the main problem of cramming a sizable adventure into a micro remains. This is the text output by the computer on to the screen. There must be descriptions for every location, perhaps more if the location can change in some way. There must be one or more descriptions for every object. There must also be responses to the player's actions, such as 'You can't go in that direction', or 'Zing! A crystal bridge appears across the chasm', and so on.

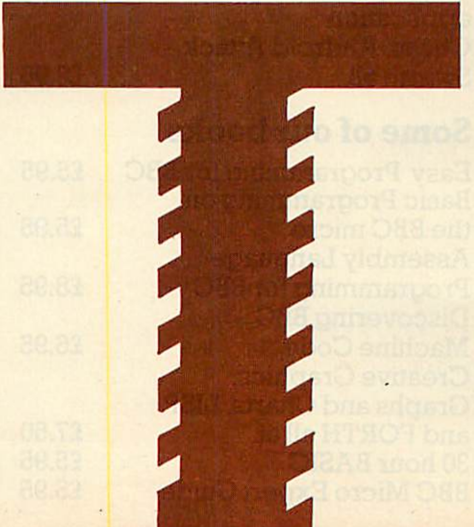
A little arithmetic will illustrate the adventure creator's predicament. Suppose you set out to write an adventure with 128 locations available to the player, and you find there are 126 responses the computer can make to various actions. If we assume there are a modest number of objects in the game, and neglect the text descriptions of the objects, this game will need 256 separate text outputs.

The memory available to store these text strings depends on how much the rest of the program takes up, and which micro you are using. With the BBC micro, mode 7 leaves a little less than 28k available (a little more if you bend the rules and move PAGE down). Let us imagine, rather generously, that only 10k is used up by the input procedures, program, tables of input words, and the data tables that define the connections between locations, the positions of objects, the results of various actions, and so on.

This leaves 18k for the 256 text strings. If the strings are stored in the normal manner used by Acorn Basic, they can be 72 characters long on average, or rather less than two lines of the mode 7 screen. This might be acceptable for some responses ('You can't do that', or 'Taken') but it means the descriptions of locations must be less than four lines on average. This is barely good enough even for the simplest adventure. The situation is, if anything, worse on the Atom or the Electron. Clearly, the more sophisticated commercial programs with 200 locations, many of which are described in considerable detail, and several hundred computer responses, must be doing something special.

The answer lies in text compression. Instead of one byte of a string representing one character, one byte can represent several characters, a whole word, or even a phrase. This is done already in Acorn Basic, as all the keywords are 'tokenised' in memory (*User Guide*, page 483). Words that appear on the screen as PRINT, NEXT, or GOSUB, for example, are actually stored in memory and on tape as single bytes in the range 128 to 255 (&80 to &FF). This is acceptable since the ASCII codes of normal characters are less than 128.

A similar principle can be applied to any language, including English. Many words come up time and time again, while within words certain combinations of letters such as er, th, ing, le, ea and so on are very common. In the location descriptions of an adventure game there are certain words and phrases that occur even more frequently than in normal English, phrases like 'to the north', 'you are', and 'there is'. It is these common words and phrases that are compressed into single bytes.



To perform this type of text compression, several steps are required. First, out of the 256 values a byte can have (0 to 255 or &FF), 26 must be allocated for the letters a to z, possibly a further 26 for A to Z, and 10 or 20 values for the various punctuation marks, the space character, and perhaps the figures 0 to 9. This might use up 64 values, say. The remaining values (64 to 255 in this example) can be used as tokens or 'one-byte compression codes' to trigger the output of common words, phrases, or combinations of letters.

The next stage is to construct a dictionary of all words and phrases that are going to be compressed in this way, and store them in a table in numerical order of the tokens. Choosing which words and phrases are going to be included is a tricky task, and there are several approaches. One way is to write a program that will scan the text of the game, searching for the best combinations of letters to compress. Programs of this sort are complicated, take a long time to work, or need a lot of text to work on, and do not always produce satisfactory results. (See the book by Wetherall given at the end of this article for one program designed to do the job.)

A more practical approach is to write a program that allows you, as adventure creator, to scan the text and then to pick out a word, phrase, or combination of letters which the program adds to the dictionary, and replaces by its token everywhere in the text. This is not an ideal solution, but it is simpler to implement. When all 192 tokens (64 to 255) have been defined, the end product should be a dictionary of 192 words and phrases, perhaps contained in a string array temporarily, and a thoroughly compressed block of adventure text. If the total space occupied by the two together is not a lot less than the text you started with, something has gone wrong!

The final, but by no means simplest, task is to change the adventure program itself, so that instead of simply printing a string, it takes the text and outputs to the screen either the appropriate character or the appropriate word or phrase of the dictionary, which must now be stored in a table in memory. This slows down the output procedure enormously, and it is best done in machine code.

Even with a simple do-it-yourself scheme like the one outlined above, text can sometimes be compressed by 30%, in other words to 70% of its original 'volume' of memory. In effect, this means that a lot more locations can be included in the adventure, or the atmosphere of the game can be improved by giving more detailed descriptions of various existing locations.

Various tricks can be used to improve the compression further, even in this simple scheme. Some adventure programs use only capital letters for the text (*Philos-*

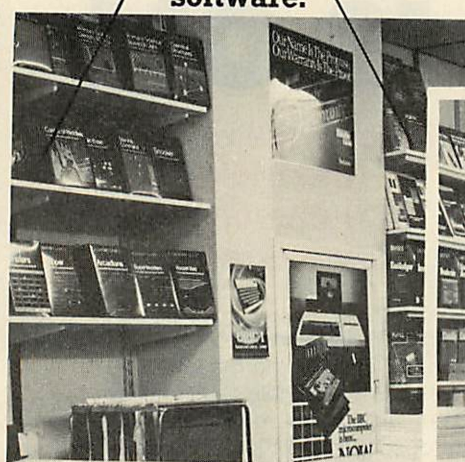
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ophers' Quest, for instance) and so need fewer 'ordinary' characters. If the digits 0 to 9 are not needed, that too means fewer ordinary characters and more one-byte-compression codes.

If you dislike reading text that is entirely in capitals, there are other methods. A special byte value can be reserved which tells the output procedure that the next character to be output should be a capital, but does not itself cause anything to be put on the screen. This makes it quite easy to put in the occasional capital letter, and gives a much better appearance to the output at the expense of a few extra bytes. It is even possible to automatically trigger a capital for the first letter after a full stop, exclamation mark, or question mark.

One further problem is worth mentioning, in case any reader is crazy enough to try implementing text compression for an adventure game. The commonest character in the English language is not a, or i, or t, or even e, though that is common enough. The commonest character is not in the alphabet, and is the last one anyone thinks of, because it is not in any words – it only occurs *between* words. It is the space character. Ever thought why the space bar is the biggest key on the computer keyboard? Because you use it so often.

The text of an adventure program would look pretty silly without any spaces, so they have to be coded somehow. Up to a quarter of the text can be spaces, so a good way of compressing spaces would be most worthwhile.

A simple way of compressing spaces, using the 192-word dictionary of one-byte compression codes described above, is as follows. First, you only compress whole words or phrases, without the spaces before and after them, and not putting the leading and trailing spaces in the dictionary table either. (This, incidentally, makes it a lot easier to automate the dictionary construction process.) When the dictionary is complete, the compression program *should* go through the compressed text removing all the spaces that occur between, before or after tokens. Now the output procedure has to be modified to output a space before every dictionary word or phrase, and another after it, as it is called up by the procedure when a token is encountered. This will produce perfectly readable text, with a few extra unwanted spaces between adjacent dictionary words and before punctuation marks. These can be removed with some simple modifications to the output procedure.

This space-compressing method may seem a bother, but it produces a dramatic effect because spaces are so common, and the spaces removed have been compressed to nothing at all. It is precisely the kind of 'cheating' technique that is most effective in compressing text or data. Overall, with a dictionary, you get 40% or even 50% compression, which means the adventure can be twice the size, or twice as good. Not to be sniffed at.

The dictionary of 192 one-byte compressions could be extended by allowing certain combinations of two bytes to point to further dictionary entries. There is an almost infinite variety of ways of extending the scheme, limited only by your imagination. At the same time, it is worth looking into other approaches to text compression, partly because they are interesting in their own right, and partly because they may be useful.

One of the crudest methods of compressing text is the five-bit technique. If the adventure creator can limit him or herself to 26 letters, the space character, and just five punctuation marks, only the numbers 0 to 31 are needed to code them. In binary, these numbers can be written using five bits (00000 to 11111). So text like this can be compressed by a factor of 5/8 (37.5% compression) simply by turning the string of bytes into a string of five-bit numbers. The five-bit numbers run through the computer's memory contiguously, overlapping the byte boundaries, and have to be unpacked by some natty programming in the output routine. Five bytes are taken at a time, and split into eight five-bit numbers. This is obviously best done in machine code.

The famous CP/M system adventure *Zork*, which runs on Z80 machines and comes on half a dozen eight-inch discs, uses a compression system something like this. Once it has been set up, it is simple and reliable, and needs no dictionaries.

A rather more fundamental approach is to code the text as a stream of bits rather than bytes or five-bit numbers. The way this kind of compression works is best illustrated by an example. There is a subroutine for getting the 'next bit' from memory, that is, the next higher bit of the current byte, or if the top (seventh) bit of that byte has been reached, the lowest (0) bit of the next byte. The output procedure might then work schematically as follows:

```
START: Get the next bit
       If it is a 0, output a space: goto START
       If it is a 1, get the next 2 bits and . . .

       If they are both 0, output an "e": goto START
       If they are 0 and 1, output an "a": goto START
       If they are 1 and 0, output a "t": goto START
       If they are both 1, get the next 2 bits and . . .

       If they are both 0, output . . .

       (and so on, eventually reaching . . .)

       If they are 1 and 1 and 1 and 0, output a "!": goto START
       If they are 1 and 1 and 1 and 1, output a "z": goto START
```

I must emphasise that this is only an example. Coding of this type works through a tree structure, beginning with the top level where common characters may be output (the space character in this example) then branching through one or more bits to the next level, and so on down. Equally common characters are grouped together roughly on the same level of the tree (like e, a, and t here), with the rarest characters (z and ! in this example, with 14 others not shown) at the bottom where there is no further branching.

This is a simple example of a Huffman code. More complex kinds of branching are possible, and in real Huffman codes there might be no characters output for the top one or two levels. Huffman codes can be used for straightforward text, or can be combined with dictionaries to give even greater compression. The main difficulty is in deciding how the branching should be done, since this depends in a subtle way on how common the characters are in the text. Once the 'tree' is defined, it is not too difficult to recode the text, or for the output procedure to decode the bit-stream back into characters.

Huffman codes are very effective where there is a wide range of frequencies of characters, in other words where some characters are very common and others very rare. If the text contains 256 different characters and they are all equally common, there is no point in using a Huffman code since the text will not be compressed!

There are other ways of doing text compression, which is a game that can be played in many ways. Some adventure writers use 'nibbles', which are half bytes, or four-bit numbers. A nibble has a value from 0 to 15 (0 to &F) and is therefore the same as a hexadecimal digit. A typical nibble system might work like this:

```
START: Take the next nibble
       If it is less than 12, output a letter (the 12 commonest letters) and return to START
       If it is 13, end the output procedure
       If it is 14 or 15, take the next nibble and output one of the 32 remaining characters or punctuation marks (least common characters): then goto START.
```

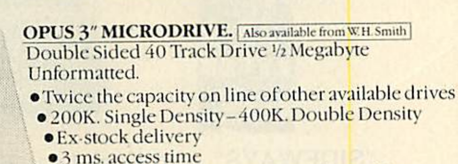
Nibbles can be combined with dictionaries in various ways, too. They are not very convenient on a machine using the 6502 microprocessor, but can be implemented, even in Basic. They are particularly suitable for Z80 machines.

Text compression is a fascinating topic, with many instructive facets, and many important uses. I could go on, but if I do not stop the editor may send this article back, telling me to use some of those fancy text-compression techniques on it. . . . ●

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WORD CRUNCHER

Vincent Fojut presents routines for compressing and expanding adventure text

TEXT compression may not give you any more memory, but it does help get the most from the memory you have. For example, using the techniques described here, an 8k block of text could be fitted into just 6k, saving 2k for further text, or extra program code.

Figure 1 shows how the compression process works, using the 4-byte string 'ATOM' as an example. By subtracting 20 hex from ASCII characters in the range &20 to &5F, the possible range of values – (0 to &3F) – can now be held in just six bits, as opposed to the eight bits normally used. Since 4 * 6 bits = 24 bits (ie three bytes), we can pack what was originally four ASCII bytes into just *three* bytes of compressed characters. The expansion process is simply a reversal of the above.

Program 1 is the text compression program. Strings of up to 255 characters can be entered, which the program then checks to ensure no invalid characters are present. No lower-case or control characters should be entered within the string (though the former restriction could be

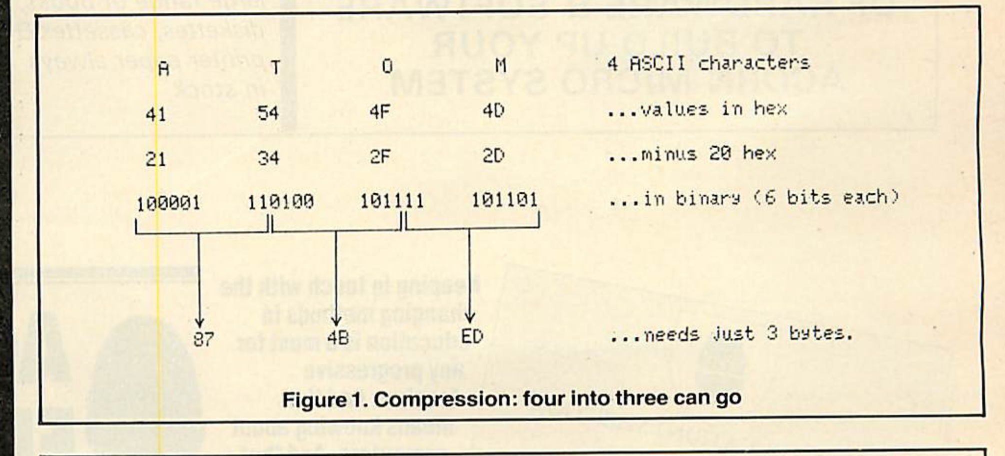


Figure 1. Compression: four into three can go

```
START ADDR. FOR TABLE?&4000
STRING No. 0
?YOU ARE NOW ENTERING
STRING No. 1
? A LARGE MANSION
STRING No. 2
? A DARK CAVERN
STRING No. 3
?
DO YOU REALLY WANT TO EXIT (Y/N)?

3 STRINGS COMPRESSED (0-2)

 *SAVE"CTABLE" 4000 402A


b)  (All values in hex)
4000  14                                        (orig. length of string 0)
4001  E6 FD 40 87 29 40 BA FD C0 96 ED 25 CA 9B A7  (compressed string 0)
4010  10                                        (orig. length of string 1)
4011  02 10 2C 87 29 E5 02 D8 6E CE 9B EE          (compressed string 1)
401D  0E                                        (orig. length of string 2)
401E  02 10 24 87 2A C0 8E 1D A5 CA EB             (compressed string 2)
4029  00                                        (zero marks end of table)
```

Figure 2. Compression in action (a) original strings entered (b) resultant compressed string table

Program 1. String compression

```
10 REM       STRING COMPRESSION PROGRAM.
20 REM COMPRESSES STRINGS OF ASCII CHARACTERS
30 REM IN RANGE &20 TO &5F BY FACTOR OF 4:3
40 REM          (C) V. FOJUT 1983.
50 :
60 PROCinitialise
70 PROCmain
80 PROCterminate
90 END
100 :
110 DEFPROCinitialise: REM Set up machine code & variables
120 PROCassemble
130 DIM str 255
140 stringno=0
150 INPUT "START ADDR. FOR TABLE",start$
160 start=EVAL(start$)
170 table=start
180 exit=FALSE
190 ENDPROC
200 :
210 DEFPROCmain: REM Get strings until exit or table full
220 REPEAT
230   PRINT"STRING No. "; stringno
240   INPUT LINE $str
250   IF LEN($str) > 0 PROCstr_check ELSE PROCexit_check
260   UNTIL stringno > 255 OR exit
270 ENDPROC
280 :
290 DEFPROCterminate: REM Mark table end; Print table info
300 ?table=0
310 IF stringno > 255 PRINT'"TABLE FULL"
320 PRINT';stringno;" STRINGS COMPRESSED (0-";stringno-1;")"
330 PRINT'" *SAVE""CTABLE"" ";~start;" ";~table+1
340 ENDPROC
350 :
360 DEFPROCstr_check: REM Compress if ok, else print error
370 PROCvalidate
380 IF valid PROCcompress ELSE PRINT"INVALID ASCII, TRY AGAIN"
390 ENDPROC
400 :
410 DEFPROCexit_check: REM Prevent accidental exit
420 REPEAT
430   PRINT"DO YOU REALLY WANT TO EXIT (Y/N)?"
440   reply$=GET$
450   UNTIL INSTR("YNyn",reply$)
460 IF reply$="Y" OR reply$="y" exit=TRUE
470 ENDPROC
480 :
490 DEFPROCvalidate: REM Check for ctrl chars & lower-case
500 valid=TRUE
510 FOR N=0 TO LEN($str)-1
520   IF str?N < &20 OR str?N > &5F valid=FALSE
```

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```
530    NEXT N
540 ENDPROC
550 :
560 DEFPROCcompress: REM Put converted chars into table
570 ?table=LEN($str): table=table+1
580 FOR B=0 TO LEN($str)-1 STEP 4
590   FOR C=0 TO 3
600     A%=?(str+B+C)-&20
610     X%=table MOD 256: Y%=table DIV 256
620     CALL shift
630     NEXT C
640   table=table+3
650   NEXT B
660 :
670 remainder=LEN($str) MOD 4
680 IF remainder: table=table-3+remainder
690 stringno=stringno+1
700 ENDPROC
710 :
720 DEFPROCassemble: REM Generate machine code
730 tabptr=&80
740 DIM code 50
750 FOR J=0 TO 2 STEP 2
760   P%=code: [ OPT J
770   .shift
780   STX tabptr: STY tabptr+1 \Set pointer.
790   ASL A: ASL A: LDX #6     \Shift
800   .nextbit                 \top six
810   LDY #2: ASL A            \bits of
820   .ripple                  \accumulator
830   PHA: LDA (tabptr),Y      \into next
840   ROL A: STA (tabptr),Y    \free six
850   PLA: DEY: BPL ripple     \bits of
860   DEX: BNE nextbit         \string table.
870   RTS: ]: NEXT J
880 ENDPROC
```

Program 2. Expands compressed strings

```
10 REM String expansion program. Expands 6-bit
20 REM compressed chars. into 8-bit ASCII
30 REM values (range &20 to &5F). References
40 REM table of up to 256 strings, each up to
50 REM 255 chars. long. On entry, X-reg. holds
60 REM no. of string required. Table & table+1
70 REM hold the start address (lo,hi) of the
80 REM string table.
90 REM On exit, carry clear=string found & printed
100 REM carry set=string not found; nothing printed
110 REM    (C) V. FOJUT, 1983.
120 :
130 osasci=&FFE3: REM write char routine
140 table   =&80: REM table start addr.
150 pointer =&82: REM pointer within table
```

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circumvented). Any ASCII character within the range of &20 to &5F is valid – that is, upper-case alphabetics (including space), numerals, plus most signs and punctuation marks. The compression program builds a table of up to 256 such strings.

After saving the string-length in the above table, PROCcompress examines a valid string, four characters at a time, and compresses these into the next three free locations in the table. A small machine-code subroutine, 'Shift', performs the low-level nitty-gritty work. On entry, Shift expects to find the ASCII value (minus &20), of the next character in the string entered, to be in the accumulator. The X and Y registers should hold the low- and high-order address of the next free area in the string table. Since CALL sets the 6502s A, X and Y registers to the low-byte values of A%, X% and Y%, lines 600 and 610 are all that is needed to set up parameters for Shift. Shift then takes the converted ASCII character in A%, and shunts it, bit by bit, into the next available six bits in the string storage table.

The use of the 'LINE' option of the INPUT statement allows preceding spaces to be accepted as part of the string entered. To exit, hit return immediately, when prompted for a new string. Should you hit return by accident, all is not lost. PROCexit-check allows you to carry on as normal, if you don't really mean to exit.

When all strings have been entered, PROCterminate marks the end of the table with a zero in the place of a 'string-length' byte. It also prints information on the number of strings entered, and the size of the table. Figure 2 provides a brief example of the program in action, and gives some idea of the degree of compression involved.

Once the table has been set up and saved, the compression program has served its purpose, and can be stored or erased. Conversely, the expansion program, which returns our crunched-up text into some form of intelligibility, needs to be permanently resident in our adventure game. It should, therefore, be reasonably fast and compact – in short, an excellent application for machine-code.

'Expand' has been written to be fully relocatable. There are no absolute jumps or subroutine calls to within the body of the program itself, so you can load it anywhere in free memory, and it will still run.

As briefly mentioned above, Expand reverses the process carried out by the compression routine. Once the appropriate string is found, Expand picks out a series of three-byte chunks from the compressed string. Each chunk holds four compressed characters (six bits each), which are converted and printed in turn. The process continues until all characters in the string have been printed. The total number of characters in the string is held in a 'string-length' byte at the beginning of each entry in the table. This is picked up by Expand at label 'check-no'. If the expan-

sion routine detects a string-length byte of zero (denoting the end of table), the program exits with the carry flag set, indicating 'string not found'.

Before using Expand, addresses &80 + &81 must be set up with the start address of the string table. This only need be done once, unless you intend to switch between a number of different tables (which is permissible). Then, before each call to Expand, load the X-register with the number of the string to be expanded and printed (the first string in the table being string 0, the second string 1, and so on).

For example, to print 'A LARGE MANSION' (string 1 in figure 2), the following code would be necessary:

```
LDA #0: STA &80          (only if table
LDA #&40 : STA &81  address not already
LDX #1: JSR expand           set up)
```

Similarly, to construct the phrase 'YOU ARE ENTERING A DARK CAVERN', again using figure 2's strings as an example, try:

```
LDX #0: JSR expand
LDX #2: JSR expand
```

The above example shows how a larger string can be built up from a series of smaller, versatile sub-strings. By judicious selection of these sub-strings (eg, a range of suitable subject nouns, verbs and object nouns) a wide variety of phrases could be generated, which would belie the amount of storage required. Specific value ranges could be reserved for given sub-string types, to facilitate sentence generation. For example:

string	*string type*
0-30	subject nouns
31-70	verbs
71-90	adjectives

and so on.

However, sentence generation is a complex and worthy subject in its own right!

The more adventurous among you (if you'll forgive the pun) may wonder how the programs could be expanded to cater for lower-case characters. By sacrificing a little-used character value, such as &5E, the necessary processing would not be too difficult.

The comparison program could scan the string entered for any changes from upper- to lower-case (and vice-versa), and embed a value of &5E in the compressed string, at the appropriate point. Note that lower-case characters would have &40, not &20, subtracted from them to fit into six bits. In turn, the expansion routine, on detecting a value of &5E, would recognise it as a 'case-shift' indicator, and make the appropriate conversion (adding &40 or &20, as appropriate, to the subsequent compressed characters).

With minor modifications, the compression and expansion techniques outlined above would make a useful adjunct to any word-processing system. Why not try it – if you can extricate yourself from your adventure, that is! ●

```
160 olength =&84: REM "original" string length
170 quotient=&85: REM for "compressed" length
180 buf     =&86: REM bit-shift buffer
190 DIM code 100
200 :
210 FOR J=0 TO 2 STEP 2
220   P%=code: [ OPT J
230   .expand              \Main entry point.
240   CLD
250   LDA table  : STA pointer   \Point to start
260   LDA table+1: STA pointer+1 \of table.
270   INX: LDY #0
280   .check_no            \Table end?
290   LDA (pointer),Y      \Loop till string
300   BEQ not_found        \found, or e.o.table.
310   STA olength          \Save orig. str. lgth.
320   DEX: BEQ getchars \String found.
330   \
340   LSR A: LSR A         \String not found:
350   STA quotient         \Calculate compressed
360   LDA olength          \length from original
370   SEC: SBC quotient \string length,
380   SEC: ADC pointer     \add to table pointer
390   STA pointer          \and continue
400   BCC check_no         \string search.
410   INC pointer+1
420   BCS check_no
430   \
440   .getchars               \Expand & print chars.
450   LDX #256-3              \Put 4 compressed
460   .loop                   \chars. into
470   INY: LDA (pointer),Y \ 3 bytes of
480   STA buf+3,X             \buf,buf+1,buf+2.
490   INX: BNE loop
500   \
510   LDX #4                  \For each of 4 chars.-
520   .nextchar
530   LDA #04                 \Shift 6 bits
540   .nextbit                \(1 comp. char.)
550   ASL buf+2: ROL buf+1 \into accum.,
560   ROL buf: ROL A          \add &20 to convert
570   BCC nextbit             \to ASCII,
580   ADC #&1F: JSR osasci \and print it.
590   DEC olength: BEQ end_ok \Continue
600   DEX: BNE nextchar        \till end
610   BEQ getchars             \of string.
620   \
630   .end_ok
640   CLC: RTS     \Carry clear; all ok.
650   \
660   .not_found
670   SEC: RTS     \Carry set; string not found.
680   \
690   ]: NEXT J
700 PRINT" *SAVE""EXPAND"" ";~code;" ";~P%
710 END
```

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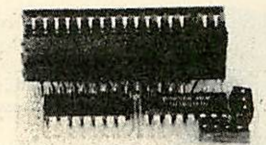
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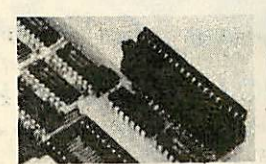
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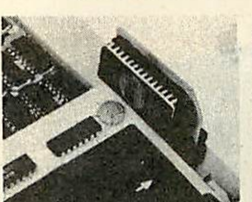


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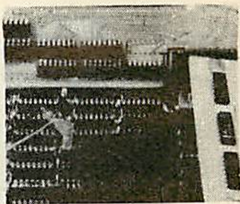




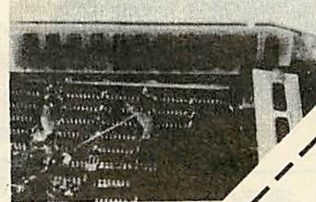
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TRALL & ERROR

Barry Pickles, who spoilt your Christmas with a craftily coded game, now reveals all

FOR those of you on the verge of insanity, still trying to decipher the listing given last month, here's the answer:

To decode listing 2, load the game and type the following:

F=0; G.180 (CR)

After a few minutes, you will get an error message – this is normal. Now type ?18=#30 (CR) and list. What you should now see is a normal Atom Basic program, looking like listing 3. Now we can look at the whole thing, beginning with the preliminary program – listing 1 of last month.

Line 10 assembles the music routine, of which more later. Lines 20-140 introduce the game, after which line 150 calls the decoding subroutine. Line 160 moves the text space to the main program (listing 3 overleaf) and calls this as a subroutine. On return, a call is made to the subroutine which re-encodes the main program, after which the 'GAME ENDED' message appears.

Subroutine 'd' is the decode routine. Line 185 looks at the first character of line 20 in listing 3. If it's an 'a', the program is already decoded, so the subroutine terminates. Otherwise a loop starts at line 190 that takes each ASCII character and reduces its value by 1. Thus, b becomes a, c becomes b, and so on.

Line 190 checks that the end of the program has not been reached (ie, #0D followed by #FF), in which case the terminating flag (F) is set, control passes to p, and the subroutine terminates. Line 200 looks for the (CR), marking the end of a line. If found, the counter (P) jumps forward by 3, to avoid encoding the line numbers.

Subroutine 'c' is similar, except that it increases the ASCII value by 1, thus re-encoding.

Now for the music – subroutine 'm'. This uses a string ($T) to store notes whose values are indicated by the letters A to G, as on a normal piano keyboard. A space is recognised as a rest and # indicates a sharp. Preceeding a note by ↑ (the up-arrow), changes up an octave, while a full stop changes back down. $T begins at #28A8 and the actual note values are stored as vectors (V), beginning at #2870. Line 300 looks up the value of the Y'th letter in $T and compares it first with an up-arrow (line 310), then a full stop (line 330), then a (CR) – to mark the end of the string and thus the end of the routine – and then a space (line 350).

The next test is for characters in the range A to G (line 360) and the final test is for a # character (line 380). In each case, an offset for the vector V is stored in #83. In the case of an alpha character, its value is first reduced by 64, then multiplied by 2 (line 370). A and Y now obtain the note values (line 400) and the rest of the routine toggles the speaker, for a frequency and duration determined by these values.

The duration is initially determined by D (line 480), which must be divisible by 256, and this is used by subroutine t to set up a table of durations, according to the formula in line 490. You will note that the durations are a product of the frequency, as suggested by the Atom manual. As I've said before, this is not really my own routine, but it is effective and easy to use. It is used to good effect in the decode and encode routines, so that you know something is happening.

On to the main program (at last!). Get ready to groan.

In line 20 of listing 3, two values (Y and

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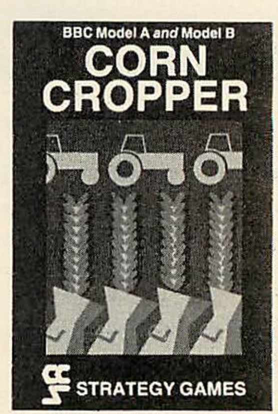
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E) are randomly generated. The game begins at line 40, which accepts your input string. The length of this string is subtracted from E to give Q, and it is Q that determines whether or not you are correct, or how close you are. So, you see, it's not what you enter at the keyboard but how long the string is that determines your success. Every time your input string exactly matches the length determined by E, you get a point (variable C – line 50). When the number of points matches the value of Y, you've done it. Ever been had?

As for the rest of the game, the computer's response is made by stripping the first four characters of your input string and replacing "Is it" by "I am" (lines 40 and 80). Lines 100 to 120 give appropriate responses for 'misses' and the whole thing loops back at line 130, until you 'find' the treasure, when control is passed to the message routine at line 140.

To add a touch of excitement, line 70 contains a 'trap' (randomly set), which, if activated, directs the program to line 370. Whatever happens, the routine terminates at line 360, sending you back to end the game.

I hope that you enjoyed the game, despite being led up the garden path.

```
20aDIMA64;Y=A.R.%5+1;E=A.R.%10+15;C=0
30P."OK, WHAT'S THE FIRST QUESTION"'
40sIN.$A;L=LENA;Q=ABS(L-E);$A=$A+5
50IFQ=0 C=C+1;IFC=Y G.e
60IFL<5 P."DON'T UNDERSTAND-TRY IT ANOTHER WAY"';G.s
70IF A.R.%50=13 $T="C A ";G.y
80P."I AM"$A'"MY SENSORS INDICATE "'
90IFQ=0 P."YOU ARE very CLOSE"';$T="A#C#G# ";LI.M;LI.M
100IFQ>0 ANDQ<6 P."YOU ARE CLOSE"';$T="ACG";LI.M
110IFQ>5 ANDQ<11 P."YOU ARE SOME DISTANCE AWAY"';$T="C A";LI.M
120IFQ>10 P."NOTHING"';LI.M
130P."WHAT NOW?"';G.s
140eP.$12''"YES!!!!!!"'';F.N=1TO3
150$T="A#C#F";T=T+LENT;?T=94;$(T+1)="A#.FC#";T=#28A8
160LI.M;N.;$T="A#";LI.M
170P."you"$128"have"$128"found"$128"it"''
180P."WELL DONE!"'"SANTA CAN BREATHE AGAIN!"'''
190F.N=1TO100;WAIT;N.;P."HOLD ON...."'
200P."I HAVE A MESSAGE COMING IN...."'
210?T=94;$(T+1)="GGG G G GG G GG G";T=#28A8;F.N=1TO4;LI.M;N.
220REM  message
230P.$12"TO ALL OUR atom READERS....."''
240P."   WE HOPE THAT YOU HAVE A TRULY "
250P."HAPPY CHRISTMAS, AND WE WISH YOU "
260P."PEACE AND CONTENTMENT THROUGHOUT "
270P."THE COMING YEAR."'
280P."THANK YOU FOR READING acorn"$128"user"'
290P."             -----------"''
300P."TONY QUINN                KITTY MILNE"
310P."           BARRY PICKLES"'
320P."   AND ALL AT  ADDISON-WESLEY"'
330$T="CF FGFED A#  DG G";T=T+LENT;?T=94
340$(T+1)="A.GFE C C ";T=T+LENT;?T=94
350$(T+1)="A AC A.GF D  CCD G E F";T=#28A8
360rLI.M;LI.M;P."PLEASE WAIT.."';?18=#29;R.
370yP.$12"OH DEAR!"'"DUE TO A FREAK SPACEWARP, I'VE"'
380P."LANDED ON THE PLANET OF TRALL"'
390P."-AND WE ALL KNOW WHAT'S THERE, DON'T WE?....."'
400P."the"$128"ravenous"$128"bugblatter"$128"beast"$129';G.r
>
```

Listing 3. The decoded version

Paul Beverley on how to prepare the VIA chip to drive a Centronics printer

VERSATILE LINK TO A PARALLEL PRINTER

IN THE December issue I explained how to add a 6522 versatile interface adaptor (VIA) on to the edge-connector of the Electron. This provides two input/output ports, two hardware timers and shift register facilities which enable the Electron to be used for various interfacing applications. Last month I explained how to use the 6522 to provide a high-speed parallel connection to a BBC microcomputer to enable you to download software. In this article I'll explain how to use the 6522 to drive any printers which use the Centronics-type parallel interface.

The 6522 itself has two ports, known as PB and PA. Both can be used either as input or output. Indeed, every line of each of the two ports can be individually programmed as an input or an output. However, the electrical characteristics of the two ports are not the same—PB has a higher current driving capability than PA.

Although both can be used as either input or output, it seems that the idea in the minds of the designers of the chip was that PA would tend to be used as input and PB as output, hence the smaller current capabilities of PA when used as output.

The designers of the BBC micro, however, decided that since they wanted to use one of the ports solely as a parallel printer output and the other as a user input/output port, they would improve the electrical characteristics of PA by adding a buffer chip, and leave PB available for the user. It would seem sensible, therefore, to do the same thing with the Electron.

It was with this in mind that I used PB as the port for receiving parallel data from the printer port of the BBC. However, to use PA as a printer output you have to add a buffer circuit similar to the one used in the Beeb (figure 1). This consists of an octal buffer (74LS244) to provide buffering for the eight data lines and two transistors for the CA2 output line, which provides the 'strobe' signal for the printer. The reason for using two transistors is that the BBC computer uses a spare inverting gate to drive a single output transistor, so we need a double inversion to get back to the non-inverted signal. The 'acknowledge' input line is CA1 and this simply needs a 4k7 pull-up resistor.

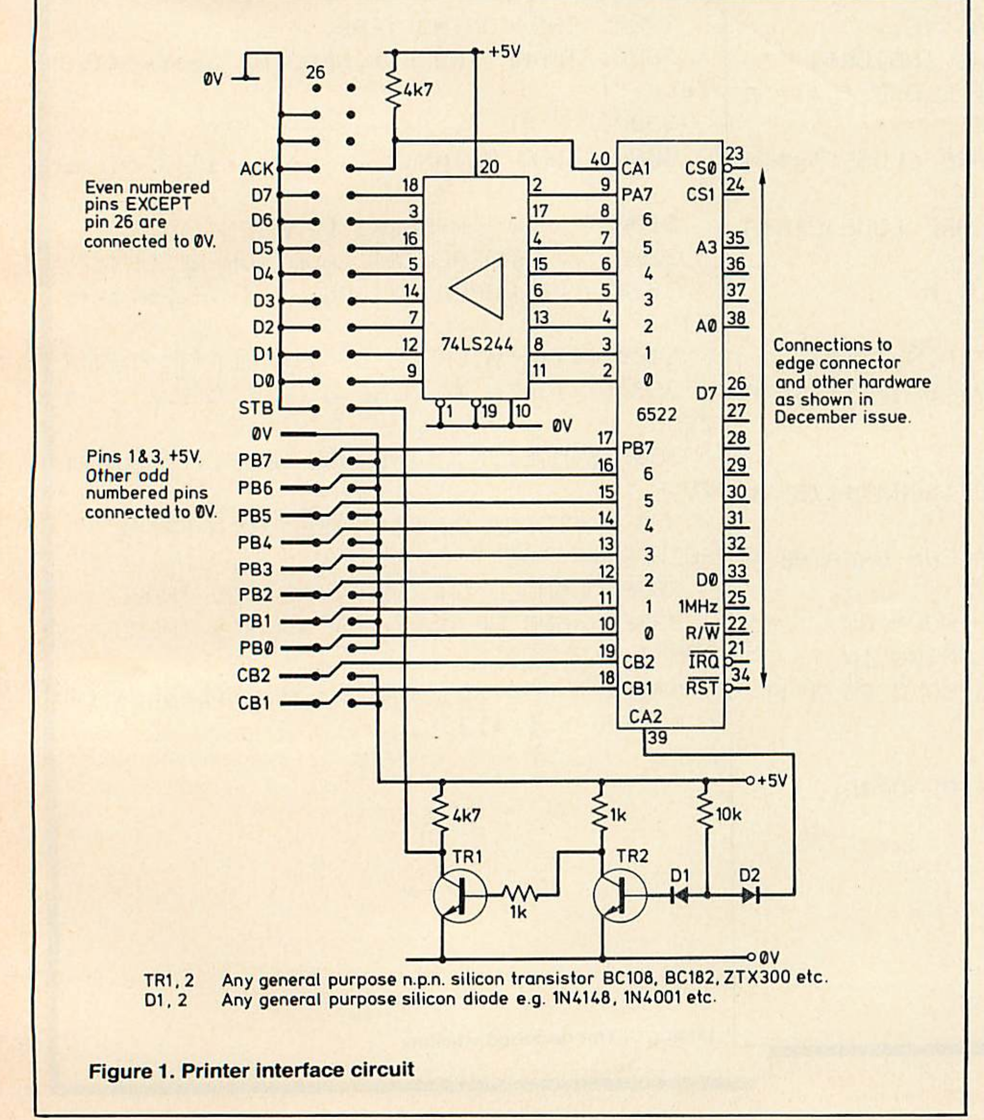


Figure 1. Printer interface circuit

It is possible to exchange the roles of PA and PB and use PB to drive the printer directly. It has just about enough current-driving capability to cope with Epson printers without using extra buffering, but with one or two other printers you would be working on the edge of the 6522's capability. Also, if you make a mistake in wiring, or short out various pins, it is a lot less expensive to replace a 74LS244 than the 6522 VIA itself.

To enable you to use PB instead of PA, I show which lines need changing in last month's downloading program (page 63) to deal with port B instead of port A: If you want to do this – and therefore want to download software using port A – substitute as follows:

```
50 portA=&FCC1
710 LDY portA
840 LDA #&EC
```

However, there is another good reason for using PA for the printer port rather than PB. The 6522 has two internal 16-bit counter/timers and an 8-bit shift register which communicate with the outside world through PB6, PB7, CB1 and CB2 respectively. These facilities would therefore be unavailable if PB were to be used as the printer port.

To run the parallel printer you need a machine code program in the Electron. There are various ways to do this, but this program (listing 1) uses the so-called User Print Vector (UPTV) provided in the operating systems of both the BBC Micro and Electron. It is complicated in the way it works, but the idea is that by using this vector you avoid the need for interrupts.

```
10 portA = &FCC1 : portB = &FCC0
20 DDRA = &FCC3 : DDRB = &FCC2
30 PCR = &FCCC
40 intREG = &FCCD
50 UPTV = &222
60 OSBYTE = &FFF4
70 ZP = &70
80 waking_up = ZP+1
90 active_flag = ZP+2
100
110 FOR opt = 0 TO 2 STEP 2
120   P% = &D00
130   [OPTopt
140
150   SEI
160   LDA #newUPTV MOD 256
170   STA UPTV
180   LDA #newUPTV DIV 256
190   STA UPTV + 1
200   CLI
210
220   LDA PCR
230   ORA #&0E \ (ORA #&E0)     \ set CA2 (or CB2) high
240   STA PCR
250   LDA #5
260   LDX #3
270   JSR OSBYTE                \ do a *FX5,3
280   RTS
290
300   .newUPTV
310   CMP #2
320   BCC save_registers        \ branch if A<2
330
340   CMP #5
350   BNE rts
360
370   TXA
380   CMP #3                    \ is it a *FX5,3?
390   BNE not_active
400
410   LDA #255                  \ set up user print routine
420   STA DDRA \ (STA DDRB)
430   LDA #&FF
440   STA active_flag
450   LDA portA \ (LDA portB) \ ensure flag clear
460   LDA #&7B                  \ routine going dormant
470   JSR OSBYTE
480   LDA #5                    \ make sure op. sys. gets 5,3
490   RTS
500

510   .not_active
520   LDA #0                    \ switch off user print routine
530   STA active_flag
540   RTS
550
560   .save_registers
570   BIT active_flag
580   BVC rts                   \ give up if routine not in use
590
600   STA ZP
610   TXA:PHA
620   TYA:PHA
630   JSR service
640   PLA:TAY
650   PLA:TAX
660
670   LDA ZP
680   BIT waking_up             \ has the routine woken up?
690   BVC rts
700
710   INC waking_up             \ set the flag back to 0
720   CLC                       \ inform op sys, printer not dormant
730
740   .rts
750   RTS
760
```

continued on p119

Whenever the operating system puts a character into a previously empty printer buffer, it informs you by indirecting through the user print vector with *a 1 in the* accumulator. You can then respond by setting up your own printer routine and, if necessary, preparing the printer to receive characters. The routine then tells the OS that the printer routine is active by returning from the routine with the carry flag clear. From then on, *every 10 milliseconds*, the OS offers your routine the opportunity to check whether the printer is ready to receive another character, and if so, send it one. This is known as 'polling'. If the routine attempts to take a character from the printer buffer but finds that the buffer is empty, it tells the OS that it is 'going dormant' by using an OSBYTE call (&7B). Then, when the OS adds the first of another set of characters to the printer buffer, it 'wakes up' the printer routine and starts to poll it again. If you want more details on how to write your own printer routine, perhaps for a different type of printer, refer to the *Advanced User Guide*.

In the program in listing 1, a number of variables are set up in lines 10 to 90, and the routines start at line 150. The first job is to initialise the routines by setting the user print vector to point to the routines you have written. The strobe line (CA2 or CB2) is forced high by adjusting the peripheral control register in lines 220 to 240. Lines 250 to 270 are equivalent to *FX5,3, which selects the user printer routine as opposed to any other routines. (The default value is *FX5,0 in the Electron, and not *FX5,2 as in the BBC machine.)

When the operating system indirects through the new user print vector at line 300, the accumulator will contain a number between 0 and 5 that will indicate what the OS is doing. If A=5 (ie, an FX5 has been executed), then this is recognised at line 340. At this point if the X register contains a 3 (ie, the user print routine is being selected), then the routine will declare itself as being in operation by setting its own 'active-flag'. At this stage the data direction register is set up for output (lines 410, 420) and the port is read (line 450) to ensure that the interrupt flag is initially clear.

The routine at lines 460, 470 is the 'printer routine going dormant' routine. The point of this is that although *FX5,3 has selected these routines, you have to tell the OS that the routines are ready to be 'woken up' when the first characters to be printed arrive in the buffer. At line 480 the accumulator is reloaded with 5 to ensure that the OS acknowledges the fact that a *FX5,3 has been executed.

If the accumulator contains either 0 or 1 at entry then it arrives at line 560 and checks to see if these routines are supposed to be in use or not. If they are in use then the accumulator and the X and Y registers are saved, the call is serviced, and the registers are all restored. If the call that has been serviced required the routines to wake up, the OS is informed that

```
 770   .service
 780   LDA ZP
 790   CMP #0                         \ is it a regular poll?
 800   BNE wake_up
 810
 820   LDA #2 \ (LDA #&10)
 830   BIT intREG                     \ acknowledge received?
 840   BEQ rts
 850
 860   .print_a_character
 870   LDA #145
 880   JSR OSBYTE                     \ get character from printer buffer
 890   BCS sleep                      \ go to sleep if none available
 900
 910   STY portA \ (STY portB)  \ output the byte
 920   LDA PCR
 930   AND #&FC \ (AND #&CF)
 940   STA PCR                        \ force CA2 (or CB2) low
 950   ORA #2 \ (ORA #&20)
 960   STA PCR                        \ force CA2 (or CB2) high
 970   RTS
 980
 990   .wake_up
1000   JSR print_a_character
1010   LDA #&FF
1020   STA waking_up
1030   RTS
1040
1050   .sleep
1060   LDA #&7B\ printer routine going dormant
1070   JSR OSBYTE
1080   RTS
1090
1100   ]
1110   NEXT
1120 CALL &D00
1130 *SAVE PPRINT D00 DA0 D00
```

Listing 1. Machine code program that uses the User Print Vector in the Electron's operating system

the user print routine has done so by clearing the carry flag immediately before returning. If the accumulator contains a 0 then this indicates a 10 millisecond polling call. In response to this, the routine checks to see whether an acknowledge has been received from the printer to say that it has received the last character (lines 820 to 850), and if so goes to see if there is another character waiting in the printer buffer (lines 870 to 890).

If at this stage the carry flag is set, the printer buffer is empty and so the routine can 'go to sleep'. This simply involves calling the 'printer going dormant' routine. If there is a character in the buffer then it will be returned in the Y register and this can be stored at the appropriate port before a hand-shake signal is sent by adjusting the value of the peripheral control register (lines 910 to 970).

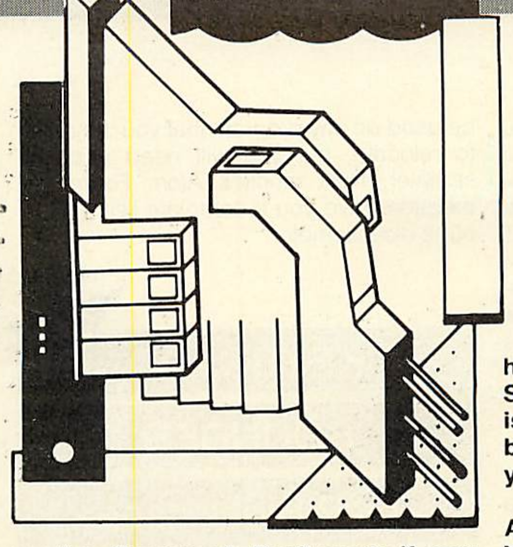
If the accumulator had contained a 1 then the OS would be informing the routine that it should 'wake up', so if A=1 (line 1000) the routine prints out a character and then sets the flag which it will check on exit from the service routine.

These routines can be set up immediately by the CALL at line 1120 or they can be saved onto cassette as a machine code program at line 1130. Once this is on cassette you simply use *RUN <return> (or */) and the routines will load in and set themselves up automatically.

The system that Acorn has provided to enable you to write a user print routine is, as you see, quite complicated. Indeed, part of the facility provided is not needed in this routine, since the printer is a fairly simple one. However, if a routine is to be written for a more complex printer, it may prove helpful to have the user print routine as a framework. For example, if you wanted to use one of the Commodore IEEE printers, which use quite complex handshaking and need special initialisation, the user print routines would be almost invaluable. However, in the case of this simple printer interface, it may be more straightforward to take advantage of *the fact that* when the OS puts a character into one of its buffers, it indirects through a vector at &22A.

If at this point the X-register contains a 3, then it is in the process of putting a character held in the accumulator into the printer buffer. Your routine could then remove this character and send it straight out to the printer, having enabled interrupts so that when the character is received an interrupt will appear on the input control line (CA1 or CB1). The operating system will not recognise this and will indirect through IRQ2V, at which point you can intercept it and remove another character.

It may well be possible using this method to devise a routine which is simpler than mine. Indeed, it may even be possible to simplify the routine provided, but it does work; even if you are not an expert in machine code programming you could type it in and be able to drive a printer ●



Barry Pickles hosts this cash-for-tips column. Here's a chance to show off your talents—and earn some crinkly green stuff into the bargain. There are reckoned to be some 40,000 of you out there and, bearing in mind that the Atom has been around for more than two years, you must have accumulated a fair amount of expertise.

What we're looking for are those little routines, tips and hardware mods you've discovered. Don't worry if your little wrinkle seems too simple—it's probably just what someone else has been looking for. The same rules apply here as in Ian Birnbaum's Beeb Forum. Short, sweet and as original as possible is the name of the game. I'll start you off, but this is your page, so let's hear from you!

Send your ideas to Atom Forum, Acorn User, 53 Bedford Square, London WC1B 3DZ. If you want it returned, enclose a SAE. It should be typed or printed, with programs on cassette (with listing if possible).

SLOW SCROLLER

WHEN listing programs to find a particular line, or section, you have two alternatives: you either perform gymnastics with your eyeballs as you try to read the listing scroll past, or set up 'page' mode, in which case I guarantee that the line you are looking for has just scrolled off the top of the screen.

Listing 1 provides a solution by slowing down the listing to a readable speed. In addition, pressing CTRL stops the list, and pressing SHIFT restarts it. It works by altering the WRCHVEC to point to this routine, which looks for a CR and delays if one is found. The delay is on line 70 and here it is 8/60ths second. CTRL and SHIFT are looked for on lines 50 and 80, respectively. Pressing CTRL causes a branch to line 80, which then loops until SHIFT is pressed. Once run, 'Slowlist' is activated by typing LINK #3CA and de-activated by pressing BREAK.

```
 5REM: slowlist
10P=#3CA;M=P+10;P.$21;[
20LDA@(M/256);STA#209
30LDA@(M%256);STA#208
40CMP@#D;BEQP+10
50BIT#B001;BVC P+13
60JMP#FE52
70LDX@8;JSR#FB83;JMP P-8
80JSR#FB81;BIT#B001;BMIP-3
90JMP P-19;];P.$6;E.
```

Listing 1. Slows down listings

CONVERTING 'DATABASE'

ACORNSOFT's 'Database' program is an excellent example of its genre, but limits you to a database of 6k. However, if the database handler were located elsewhere,

```
  5REM: "DATABASE" CONVERTOR
 10V=#2800;P.$12;GOS.c
 20P."TO WHICH ADDRESS DO YOU WISH THE
"
 30IN."PROGRAM TO BE CONVERTED"Q;Q=Q/2
56
 40!V=#37E337CE;V!4=#37F037E9;V!8=#380
837F7;V!12=#38253822
 50V!16=#38363839;V!20=#3840385D;V!24=
#38653870;V!28=#38933896
 60V!32=#38AC38AF;V!36=#38B638BD;V!40=
#38E63879;V!44=#FFFF
 70?#80=Q+#F;LI.M
 80!V=#380B3815;V!4=#37E63890;V!8=#FFF
F;?#80=Q+#E;LI.M
 90!V=#3885388B;V!4=#38C338C8;V!8=#38C
B38D1
 95V!12=#FFFF;?#80=#90;LI.M
100P.$12$7"MACHINE CODE CONVERTED"';Q=
Q*256
110P."THE 'LINKS' IN THE MAIN PROGRAM
ARE:"'
120P.&Q+#EC0,"(LINES 2050,2323 & 6010)
"'
130P.&Q+#F41,"(LINES 1100 & 2323)"'
140P.&Q+#F94,"(LINE 2100)"'
150P.&Q+#FD3,"(LINE 3310)"'''
160P."REFER TO TEXT FOR FURTHER"'
170P."INSTRUCTIONS"';?18=#29;E.
180cP.$21;P=#8F80;M=P;[
190LDY@0;LDX@0;LDA#2800,X;STA#81
200INX;LDA#2800,X;STA#82;INX
210CMP@#FF;BEQP+9;LDA#80;STA(#81),Y
220JMP P-20;RTS;];P.$6;R.
```

Listing 2. Enter at #8C00

you could use as much memory as you have available from #2900 (or #2000, if you have the BBC Basic board). The conversion is done in two parts, the machine code and the Basic text. Listing 2 will convert the machine code instantly, once you have responded to the prompt at line 30. It then goes on to tell you the new values for the 'LI.' commands in the Basic text, and on what lines you will find these. You should note these down, when they appear.

The program, which should be entered at #8C00, exits to the lower text space, so that you can list Database and alter the program lines specified. It should be obvious that you must first load Database before using this routine. You must alter all the 'LI.' commands yourself, as specified by the program, and then you need to alter three more lines, as follows:

Line 205: ?18=#29

Line 1200: Y=#2901

Line 4500: Q=#2900

This assumes that you wish your database to begin at #2900. If not, alter these lines to an appropriate value. Finally, two more lines need changing; these alterations are common, no matter where you relocate Database:

Line 10: ?35=0; ?36=#8C; . . .

Line 11: A=#8F00; . . . V=#9000

Database is now ready for relocation. It currently occupies memory from #2900 to #38EF. To move it to, say, #8200, use the block move routine given in September's *Atom Forum*. As it is slightly less than 4k long, it can be blown into EPROM using your normal routine. It would then be initialised by: ?18=#A0 and run. There will be some screen noise, but this is not too disturbing.

How does listing 2 work? Well, first I disassembled the machine code to find the locations of the jump destinations. We only need to alter the high bytes, and the vector V contains the addresses where they appear. Q is the high byte of the destination address for the new progam and, since there are three sets of jumps to be altered, #80 holds Q, offset by one of three values (see lines 70, 80 and 95). A similar offset is applied to find the correct 'LINK' addresses (lines 120-150).

Subroutine 'c' assembles the machine code. This takes, in turn, the low and high bytes of each vector (pointed to by #2800,X) and stores these in #81,82 (lines 190 and 200). Each table of vectors ends with #FFFF, so line 210 first looks for these, exiting from the routine if found. Otherwise, the current value of #80 is obtained and stored in the address pointed to by #81,82—this is known as 'post indexed indirect addressing' and is explained on page 121 of the manual.

Although this particular program has been about Database, the principles can be used on any program that you may wish to relocate, but you will need a disassembler. Next month's *Atom Forum* will therefore give you a complete listing for a 6502 disassembler.

KEYBOARD SOUNDER

£10

by P Blenkinsop

THE enclosed program (listing 3) gives the Atom a keyboard sounder. The read character routine is redirected to enter the new routine. A character is read, and a sound is emitted. The routine is useful as it gives a positive indication of a key press.

It may find a place in an educational program for young children who need to know that they have only pressed a key once. The sound routine adds a slight delay so can help to eliminate key-bounce problems that occur on some Atoms.

Line 70 Resets the read vector.
Line 80 Reads the keyboard.
Line 90 Saves the accumulator and x and y registers for later use.
Lines 100-170 are the sound routine. A change of value in line 110 or 120 will change the duration or tone of the note.
Line 180 Restores the accumulator and x and y registers.

```
10REM KEYBOARD SOUNDER
20REM*****************
30REMBY P. BLENKINSOP
40DIMVV2
50REM*****************
60P=£2800;[
70LDA@£0A;STA£20A;
  LDA@£28;STA£20B
80JSR£FE94
90PHA;TXA;PHA;TYA;PHA
100LDA£B002
110LDY@£FF
120:VV0LDX@£20
130:VV1DEX;BNEVV1
140EOR@4
150STA£B002
160DEY
170BNEVV0
180PLA;TAY;PLA;TAX;PLA
190RTS;]
200LINK£2800
210E.
```

Listing 3. Keynotes (£=#)

FAST CASSETTE IN ATOM FORTH

£5

by A P Hume

IF YOU use Forth on the Atom and you have a Toolbox ROM fitted in the utility socket, you may like to make use of the high-speed cassette option provided by the ROM. Shown below are the steps needed to achieve this with any of the Toolbox ROMs, but the addresses are for the Program Power ROM; a list of the addresses for some of the other available ROMs is given at the end. First, in Basic, type in the following program:

```
10 LET @ = 0
20 PRINT &?#215,&?#214, "  ",
&?#217,&?#216'
30 END
```

This will give the normal vectors for GETBYT and PUTBYT:

FBEE FC7C

Then select the fast cassette option and re-run the program. This will give two new addresses:

ADCO AD7D

Then for the slow cassette option:

AE10 AE16

Load and run Forth and then define the following words:

```
HEX
: NORMAL FBEE 214 ! FC7C 216 ! ;
: FAST ADCO 214 ! AD7D 216 ! ;
: SLOW AE10 214 ! AE16 216 ! ;
```

These can be saved as a screen in the normal manner, if required. In order to re-record all your screens with the high-speed option, use the COPY definition from the Acorn manual but include the word SLOW at the start of the definition of INSCR, and FAST at the start of OUTSCR.

I AM keen to receive submissions in both Forth and Lisp, as such routines tend to be transportable and will benefit both Atom and Beeb users. Let's have more – but try to make them machine specific.

Addresses for other Toolbox ROMs

		GETBYT #0214	PUTBYT #0216
Program Power	FAST	ADC0	AD7D
	SLOW	AE10	AE16
A&F Software	FAST	AECF	AE97
	SLOW	AEC9	AEF8
Disatom	FAST	A786	ACA0
	SLOW	FBEE	FC7C
Watford Electronics	FAST	A519	A4D8
	SLOW	A4CA	A4D1

The Disatom ROM uses the normal Atom vectors for its SLOW option. In this case there is clearly no need to define both SLOW and NORMAL; only one is needed.



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PROGRAMPOWERMICROPOWER

How does the micro foster learning skills in pupils? Heather Govier evaluates three simulation packages

SIMULATION= STIMULATION?

MANY computer simulations are now available for a variety of applications at primary and secondary school level, although the educational value of such programs is not always obvious, even if pupils enjoy them. The effective use of simulations can have more implications for teaching styles and classroom organisation than for curriculum content.

In the 1960s and '70s there was a move in primary schools away from rigid subject boundaries towards a topic-based approach, since followed in a number of cases by a reversion to a more structured curriculum. The original thinking behind the rejection of traditional subject boundaries, however, remains sound. Not until they reach the upper levels of higher education will pupils again be able to study and learn in an environment free from the pressure of examinations and a rigid timetable.

The primary school is an ideal place in which to teach many of the thinking and study skills which can only be acquired in a pressure-free environment. While schools were right to reject a content-based curriculum designed to inculcate facts, most have failed to replace it with a process-based approach, whereby vital thinking and study skills can be taught irrespective of subject. Topic work can consist of presenting children with an ill-assorted ragbag of facts with few connecting links and little underlying thought as to educational objectives.

At its best, however, topic work develops in children the ability to acquire information, to analyse and evaluate it and make appropriate decisions as to how it may be applied – all essential aspects of education. A sound topic-based curriculum involves a scheme of work directed towards the systematic learning of these skills and processes; the material content is left to the individual teacher.

The microcomputer has a part to play in good topic work, the most obviously useful software perhaps being the information retrieval package. Not all study consists, however, of acquisition and manipulation of facts. Children should also learn how the facts become known in the first place, how historians, archaeologists, mathematicians and scientists ply their trade to make discoveries and solve problems. Computer simulations make these processes accessible to children in a way never before possible. This article will attempt to evaluate the role of simulation in the primary curriculum by describing three simulation packages for primary schools in the diverse fields of history, science and mathematics.

Simulations enable the teacher to fulfil a variety of educational objectives. They provide opportunities for:

- **co-operative groupwork**
- **discussion, description and debate**
- **sharing the excitement and frustrations of real exploration**
- **meticulous observation**
- **careful record-keeping**
- **development of concepts**
- **the formulation, testing and refinement of hypotheses**
- **control of variables**
- **testing of new designs**
- **creative writing and artwork**
- **use of appropriate reference materials**

The problems of ensuring progression and systematic structuring of learning skills and processes still remain. They cannot be solved by a computer, only by a competent and experienced teacher, now equipped with a new and valuable tool.

THE MARY ROSE

Simulation programs for primary schools rarely come as individual items of software. They are usually supplied as part of a much wider package of associated materials in which the use of the computer is just one component. The *Mary Rose* package consists of posters, annotated diagrams, teaching notes and pupil materials which would keep an average junior class busy for a term or more.

The pack contains two items of software, one a simulation of the original search for the sunken vessel in the Solent, the other allowing pupils to play at being the divers who excavate the wreck.

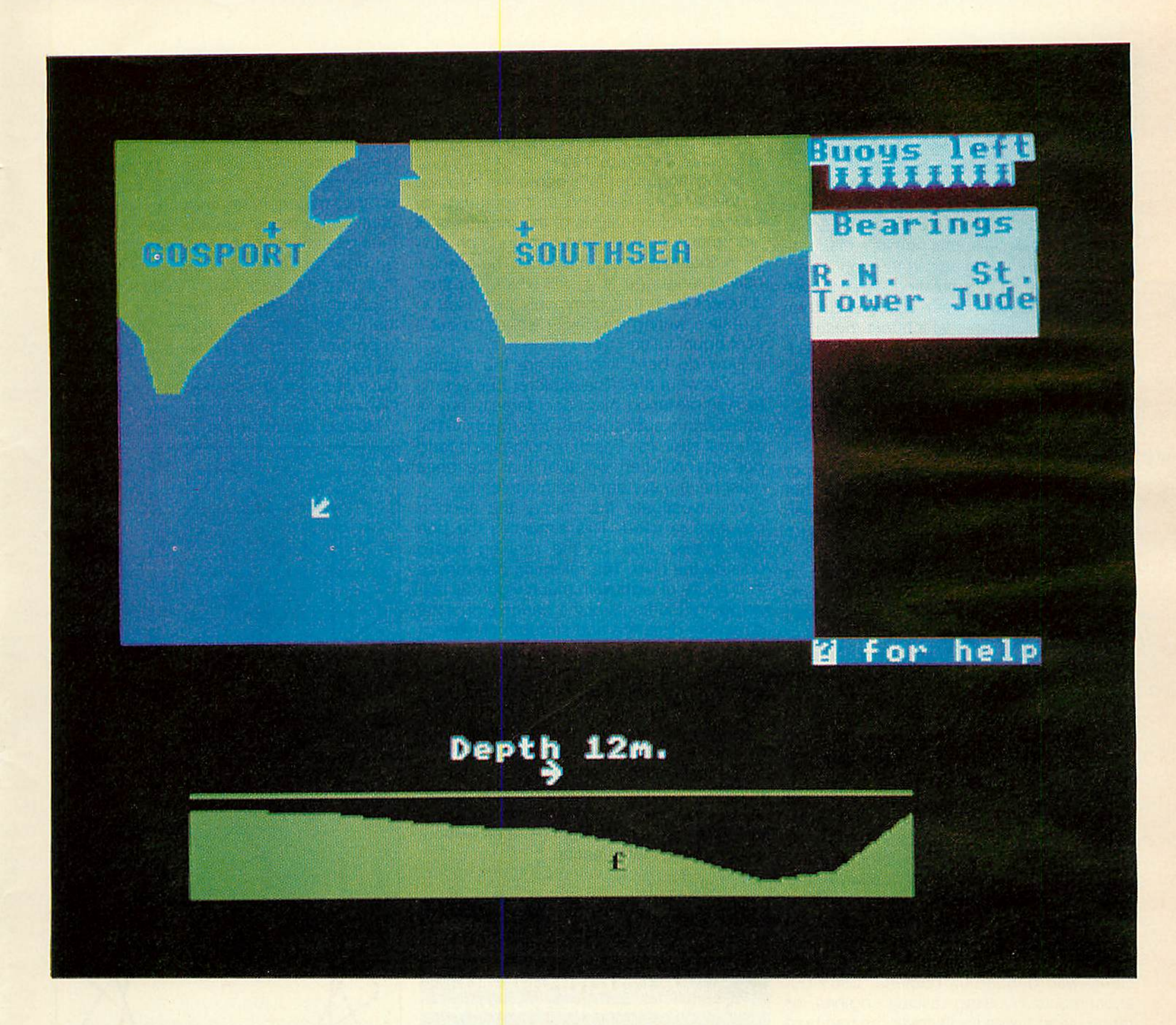
The user 'sails' the exploration vessel around a screen map. Depth soundings may be taken with an underwater scanner to reveal a profile of the seabed. On spotting any irregularity the team may send down divers, who report their findings - 'a rusty bucket' or ultimately 'signs of a wooden hull'. Buoys may be dropped to mark any point and bearings taken.

Since the area to be explored is limited and may be further reduced by considering historical evidence (for example, the king watched the sinking of the *Mary Rose* from the cliffs and reported its approximate position), this explanation is likely to take no more than a single working session.

In the main program each dive must be made in strict accordance with real regulations, with careful equipment checks and logging of progress. By clearing the mud with the air lift children are able to explore the wreck layer by layer, uncovering untold treasures on the way.

The package also contains annotated diagrams, produced by the Mary Rose Trust, of many of the interesting items found. Thus on finding, for example, the surgeon's chest, a group may refer to the diagram to discover its contents. Many of the items inside will be unknown to them and by use of reference materials (not supplied with the pack) the children learn much about the contemporary state of the science of medicine.

What does the use of the computer add to the exercise? Classes were studying the *Mary Rose*, especially when it was being raised, without the aid of the microcomputer. The project presented teachers with the opportunity to introduce their pupils to much contemporary history, to investigate the work of the undersea diver, and to learn



about nautical matters ancient and modern, such as the use of bearings and undersea scanners.

The computer adds four dimensions. First, it allows pupils to experience some of the emotional aspects of exploratory research: children are able to share in the frustrations and excitement felt by the real team of divers and historians. A group which 'runs out of air' just as it is trying to raise some significant find is certainly experiencing a taste of the real thing.

Second, use of software highlights the need for a rigorous and systematic planning of the recovery. Burrowing too deeply will result in a collapse of the surrounding mud, so silt must be cleared layer by layer. Careful record-keeping and logging of progress is essential if the team is to avoid covering old ground, and appropriate grids are supplied with the pack.

Third, as the *Mary Rose* was not resting in an upright position but on its side, the imaginary task of exploration involved spatial concepts. By modelling and drawing charts and diagrams pupils can develop an understanding that would be unattainable without the software.

The fourth and perhaps the most important contribution made by the micro is that it is an ideal focus for genuine group work, which helps to develop social skills. Commonly, group work in the primary school consists of a number of children sitting together, employed on the same task, each working in his or her own book. Most of the discussion taking place under such circumstances is idle gossip rather than profitable discourse.

The microcomputer can act as a focus for real co-operation and valuable discussion among children: the single keyboard precludes individual working; children must co-operate over decisions and communicate their views and arguments. There is scope in the program for competition – groups working against one another to collect the most treasure – but experience of using it suggests that junior pupils are more likely to co-operate than to compete. One group, finding a part of a cannon, felt themselves to be close to the main body of the weapon. However, their diving time was up and they had to surface. Instead of keeping the location of their find secret they rushed to the team due to dive next to suggest that if they tried a spot adjacent they might be able to raise the cannon.

Groups of three or four children work together, each team having a daily dive on the wreck. A joint team record is kept and all decisions taken after due discussion and deliberation. The Edinburgh study of pupils working with Logo found significant gains in their ability to communicate. It may be that these gains were not due to the use of Logo itself but to the opportunities afforded by the micro for proper co-operative group work. Such opportunities may be found in a variety of applications and are an important aspect of work with simulations.

BEES–A SCIENTIFIC SIMULATION

A major objective of science teaching in the primary school is to introduce pupils to the process commonly termed 'scientific method'. Essentially this consists of identifying a problem and asking the right questions about it, formulating hypotheses based on careful observation, and then devising experiments which test these hypotheses by trying to disprove them. Reasoned and analytical thought are necessary for this process.

It is easy in the science lesson to get bogged down with the practical problems of spilt water or faulty equipment. Science is not just about putting plants in bags or pouring solutions without spilling them, but there is a danger that children will focus on this aspect because it occupies so much of the time.

Children should be presented with a simulated experience only if the real experience would be too dangerous, too difficult or too expensive.

There seems little justification for presenting children with a computer program in which their role is to connect up a simple circuit to cause a bulb to light. This should be done with real batteries and bulbs, even if the real experience is less tidy and needs more careful organising by the teacher. Young children need concrete, practical experience to acquire concepts and screen simulation cannot replace this.

Nevertheless, using a microcomputer enables primary pupils to follow in the footsteps of some of the great scientists of the past whose work involved practical difficulties too great for young children to overcome. They can, for instance, work safely with dangerous bacteria, carry out experiments involving railway engines, or range far and wide to discover the habits of bees – all without leaving the classroom.

Bees is a series of programs which allow children to follow in the footprints of Carl von Frisch, who discovered the nature of bee communication. The first program shows a plan of a field with a hive sited just off-centre. Bees can be seen leaving the hive and flying until they occasionally rest at certain spots, called interest points. When the bees return to the hive a group then flies directly to the interest points.

Unlike the programs in the *Mary Rose* pack, *Bees* is not intended to be used by pupils working alone but is an 'animated blackboard' style of program to be used under teacher direction. The attention of pupils can be directed towards interest points and to a discussion of their possible nature. There are four interest points in the default condition of the program which can be marked by the presence of a flower. A grid overlay can be displayed and when pupils think they have identified grid references for all the points, the flowers can be switched on to verify their theory.

Pupils may notice that some of the interest points seem more attractive to bees than others, and the four points are given interest ratings. What are the bees doing? What is at the interest site?

Much language development is involved in this activity. Refining an hypothesis involves careful analysis of the meanings of words and phrases and demands creativity in finding new expressions. The precise use of language is a skill which is rather different from that commonly practised in 'creative writing' or class discussion but it is of equal value.

How do bees know where the nectar-filled flowers are? The explorer bee seems to stumble upon them accidentally but its cohabitants subsequently fly straight to the interest site. Von Frisch hypothesised (and perhaps children will too) that the bees must have a system of communication.

To investigate this theory the second program is used. This simulates the bee dance executed on the running board outside the hive. The returning bee moves in a figure of eight with much vigorous tail-wagging. Elements of the dance signal the direction, distance and strength of interest of the site, and to disentangle them is a complex task. Pupils must learn the importance of investigating one variable at a time while holding the others constant. Hypotheses can be tested by moving the hive or the interest sites around the grid and observing the behaviour of the bees.

While the program is teacher-driven, use of appropriate worksheets would allow juniors to explore the possibilities without direct teacher intervention.

SPIRO- A MATHEMATICAL SIMULATION

The spirograph is a toy which can be used to draw flower-like patterns. Typically, a set consists of two rings and 18 small wheels. The rings have teeth along both inside and outside edges and the wheels are like cogs with teeth around the outside. Patterns are made by inserting a pen or pencil through one of the holes on the wheel and rolling the wheel around inside the ring, the teeth intermeshing until the line so made closes upon itself.

There are interesting mathematical relationships between the numbers of teeth on the ring and wheel and the number of nodes or petals in the diagram produced.

Spiro, which simulates the use of the spirograph, is intended for use only after children have spent time manipulating the real thing.

A good piece of software should generate as much work away from the micro as time spent at the keyboard. In the case of *Mary Rose* this work consists of recording details, discussion and decision-making, and writing creative reports or diaries. All this is done between sessions of using the computer. With *Spiro* many hours of work must precede the use of the program.

Having collected 36 sets of data by use of the materials in the set, pupils are challenged to formulate hypotheses about their relationships. It is unlikely that they will be right first time – indeed, it is desirable that they should not be. The task of testing hypotheses, refining them, or rejecting them and formulating new ones, is an important aspect of the work. The failure of an hypothesis is not a failure for the child but a puzzle and a challenge – an essential element of the learning process.

Having discovered a 'rule' which seems

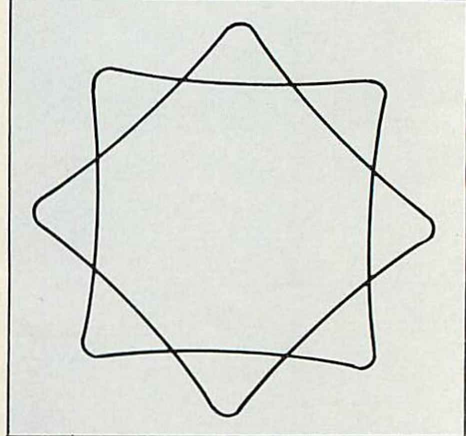


Diagram 1

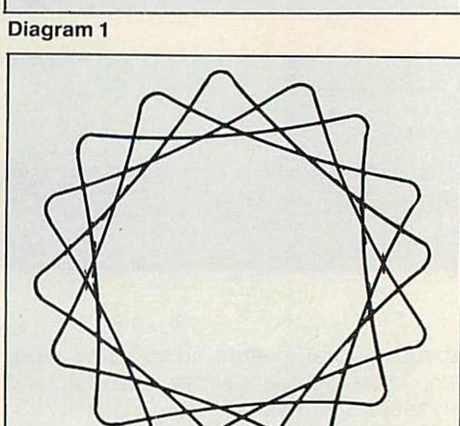


Diagram 2

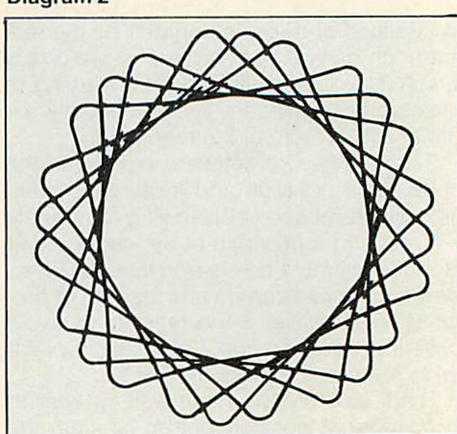


Diagram 3

to hold true for all cases, pupils are challenged to design a new spirograph with greater potential and flexibility than the original. It is here that the computer simulation really comes into its own. It would be impractical to ask children to build a new spirograph but it is a simple matter for them to test their design by means of the simulation.

Further work with the program involves writing procedures to solve visual puzzles that consist of a number of patterns superimposed. Diagram 1, for example, consists of two four-noded diagrams, the second one offset 45 degrees relative to the first. Thus if the four-noded diagram had been defined as "FOUR" the set of instructions to produce diagram 1 would read:

```
REPEAT 2
FOUR
OFFSET 45
AGAIN
```

Here the spirograph program is acting as a Logo microworld. The physical restrictions of the original toy have been removed and the opportunities for exploration and challenge are boundless.

One danger inherent in the use of this kind of simulation is that pupils seem to put more reliance upon the evidence provided by the computer than on evidence gained through use of the real tool. In the case of the spirograph the reasons for this are easy to find. Physical manipulation of a real spirograph is not an easy task, especially on complex diagrams, so the children prefer to glean data from the computer simulation where the pen cannot slip and the nodes are counted as they are produced.

Children should be encouraged to question 'facts' provided by a computer just as much as those found in 'print'. It is interesting to note in this context that children put even more faith in the printed word than that found on the screen. Where the spirograph box contains illustrations of the 36 possible patterns pupils use this to verify the computer output. Caxton, it would appear, still rules.

Mary Rose is available from Ginn & Co.

Bees and *Spiro* are being developed as part of an MEP project entitled 'Problems & investigations in the Primary School Using the Microcomputer as a Resource', based at the Davidson Teachers' Centre, Croydon.

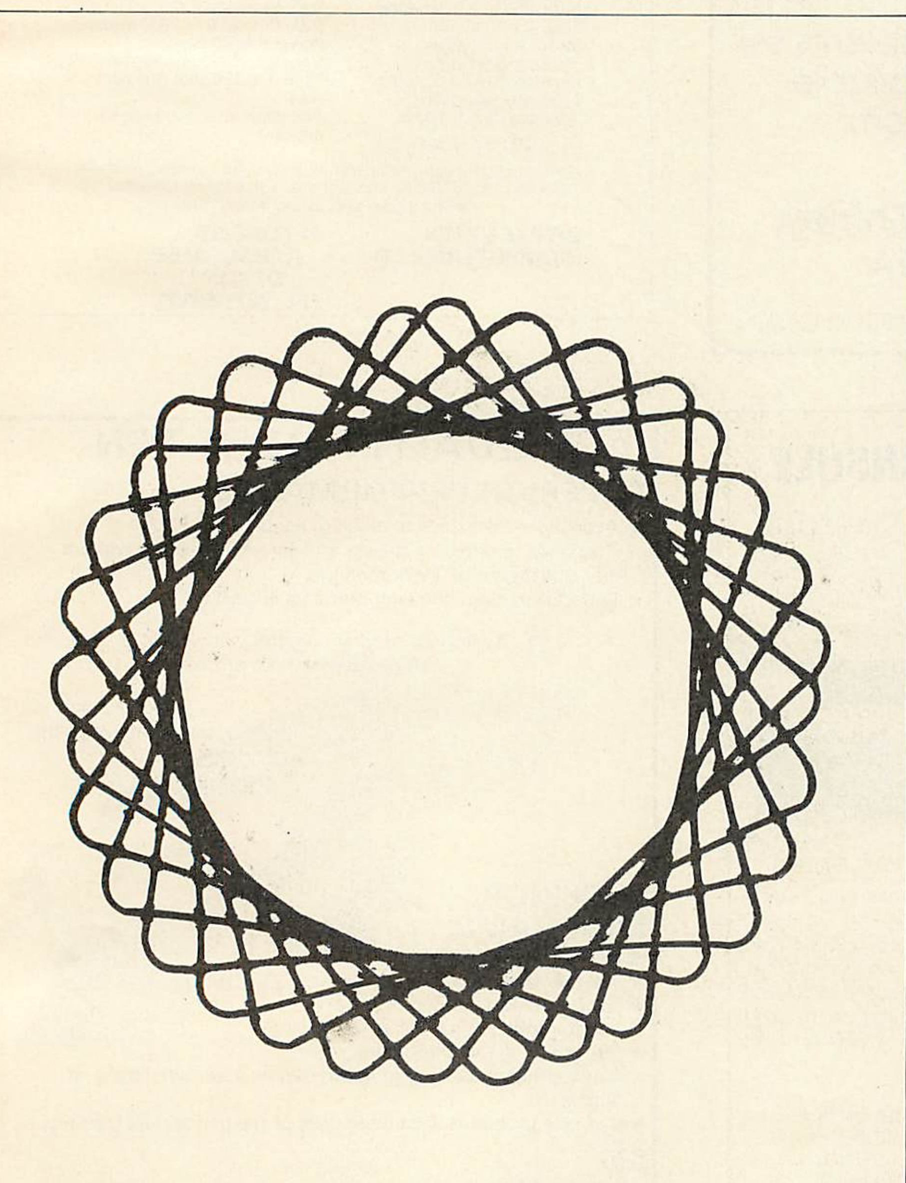


Diagram 4

POINTS TO REMEMBER

1. **Good simulations take time because they have to be incorporated into other educational activities.**
2. **Simulations are most productive when used with small groups of pupils.**
3. **Programs should not simulate activities in which the practical handling of materials is an important educational objective.**
4. **Pupils must learn to test the model in a simulation before they are willing to accept the computer's results.**
5. **Computer programs should only simulate activities which would otherwise be too dangerous, too expensive or too tedious.**
6. **Realistic simulations often need large storage space and this implies disc drives on the BBC microcomputer.**
7. **Some simulations can stimulate interest but also distract attention from the educational objectives.**
8. **Simulations allow children to experience how scientists, mathematicians and historians make discoveries.**
9. **Good simulations should help pupils to understand the need for a systematic attack on a problem.**
10. **A good test of a simulation program is how much pupil and teacher material is supplied by the publisher.**

EXCITING POSSIBILITIES IN A SIDEWAYS RAM

Sideways RAM expansion system, Solidisk Technology, 17 Sweyne Avenue, Southend-on-Sea, Essex SS2 5JJ (0702 354674).

IN VIEW of the rapid development of various ROM-based languages and utilities for the Beeb, many users may be considering an expansion board for extra 'sideways ROMs'. Others might like to try developing their own ROM-based software. A new product from Solidisk Technology, the sideways RAM expansion system, should interest both camps. By using RAM in the area normally occupied by a sideways ROM a number of benefits are claimed.

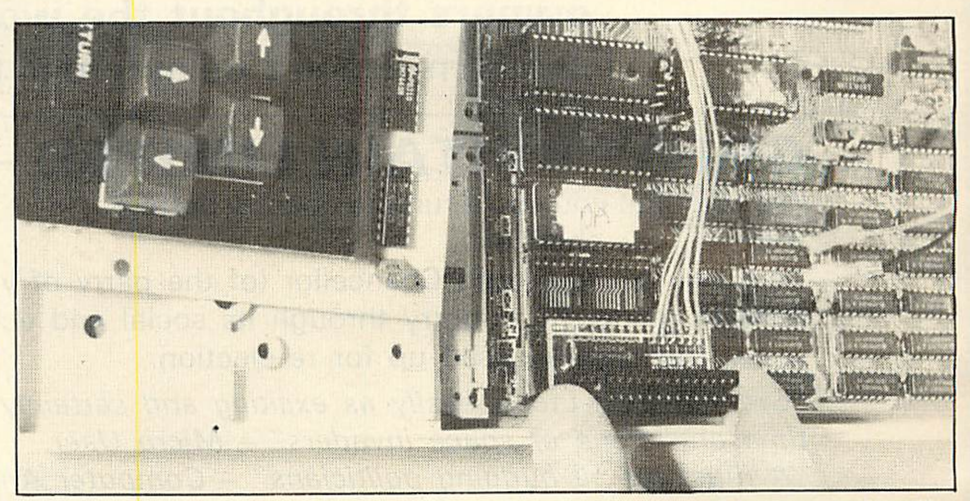
How close does the system come to meeting these claims?

At 16k, Solidisk's sideways RAM board is the baby of a family of RAM expansion modules, going right up to 'silicon discs' of 128k or so. The 16k model consists of three hardware elements: a 'cartridge base', a 'ROM cartridge' and the 16k sideways RAM card itself. Also included are a few pages of instructions and a 40-track disc containing a number of utility programs (see table 1).

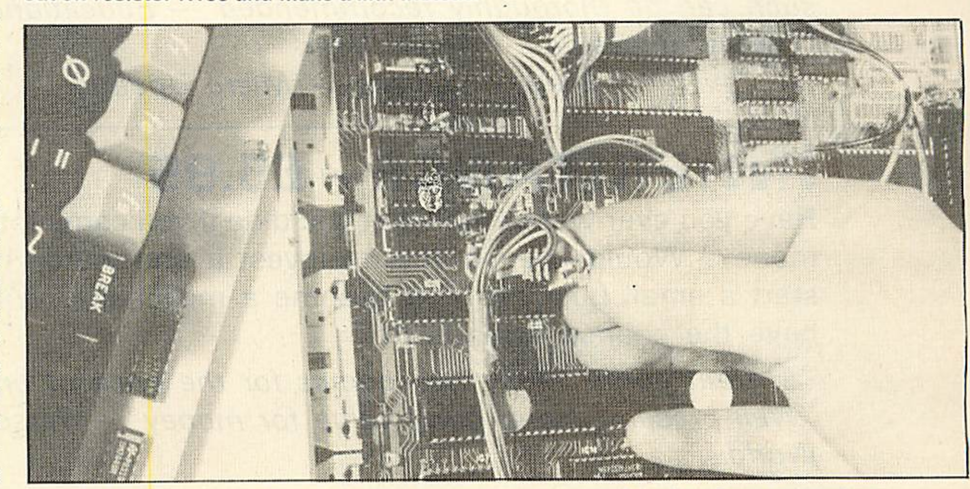
The cartridge base is a minuscule PCB which fits, via 28 pins, into the rightmost sideways ROM socket on the BBC's circuit board. Six additional 'control wires' lead from the PCB, four of them connected, via a pair of jumpers, to links S20 and S22 on the board, and the other two inserted into pins on the 6502 CPU socket. The ROM cartridge is an even smaller PCB, which holds nothing more than a 28-pin IC socket, to accommodate a sideways ROM. The ROM cartridge can then be plugged into a mating edge-connector in the cartridge base. In this configuration, the BBC micro behaves as normal, just as if the sideways ROM in question were installed directly in the rightmost socket.

Now for something completely different. Remove the ROM cartridge and install the 16k sideways RAM via the same indirect connector on the cartridge base. You now have an extra 16k of RAM which can be accessed like any other sideways ROM. What can you do with it?

First of all, you can now commit a potentially infinite number of ROM-based utilities to disc (or even tape), and then load them into sideways RAM as and when required. Using this technique, you need never worry about extra ROM expansion boards. Admittedly, loading the programs from disc isn't as fast as switching between ROMs, but a few seconds' wait is a small price to pay for the extra versatility. Two programs on the disc have been specially provided to facilitate the transfer of ROM software to disc. The first, *COPY 2*, saves any ROM that is already fitted to the main BBC board; the second, *ROMCOPY*, saves any additional ROM installed via the ROM cartridge.



Push the base unit firmly into place. With issue 3 motherboards, bend down or – better still – cut off resistor R153 and make a link instead.



Remove two jumpers at locations S20 and S22 and install the wire plugs as labelled.

The second advantage is that users can develop their own sideways ROM software more easily by storing, testing and running code in the very locations it will ultimately occupy. Normally, one would have to program an EPROM, then erase and reprogram it whenever bugs appeared. Now all you need to do is set P%=&8000 (or above), and machine code will be assembled exactly where you want it. This is of particular benefit to Basic I users, to whom the dual assembler pointers, 0% & P%, of Basic II are not available.

How can you assemble code at &8000 onwards when the assembler you're using (in the Basic ROM) also resides at &8000 onwards? The answer is that the system can distinguish between read and write cycles from the CPU. A read cycle will select the Basic ROM as the assembler is running, while a write cycle selects the sideways RAM whenever the generated object code needs storing. This has one unfortunate, but slight, side-effect. Although the correct machine-code is generated and stored for addresses above &8000, the hex values displayed by any assembler listing will be incorrect – see

FILENAME	FUNCTION
!BOOT	Loads and runs AC90MOD.
AC90MOD	Object code for Solidisk's modified version of Acorn's DFS 0.90.
COPY2	Copies sideways ROM, on BBC board, to disc.
ROMCOPY	Copies sideways ROM, on ROM cartridge, to disc.
STL0E00	Source code for AC90MOD.
STLDISC	Source for 'silicon disc' program (for larger SWRAMs)
SWR1	Demo: how to move sideways ROM code to sideways RAM.
SWR2	Demo: how to call machine code in SWRAM from Basic. (Example saves and restores a hi-res screen to and from SWRAM).

Table 1. Solidisk's sideways RAM utilities disc

listing 1 (the values displayed are, in fact, those in the Basic ROM at the specified addresses).

Another exciting possibility is that of modifying existing ROM-based programs. To give you a concrete, and useful, idea of what can be achieved, Solidisk have developed a modified version of the Acorn DFS. The new version resides in sideways RAM, along with the RAM-based workspace needed by the DFS. In other words, you can now use addresses &E00 to &1900 for your own Basic (or other) programs and still use all the facilities of the DFS, which now has its own private, uncorrupted workspace in sideways RAM. Of course, if you use this RAM-based version, you cannot load another utility into the sideways RAM without overwriting the RAM-DFS. However, even this potential problem could be circumvented. Solution? – buy a bigger sideways RAM board.

The extra RAM is an ideal location for storing machine code; to be called by Basic, or even RAM-based languages like Forth or Lisp. The more machine code you can store above &8000, the more space you have in lower memory for actual Basic code, or whatever. Similarly, any application requiring large areas for data storage could exploit the extra sideways RAM. The utilities disc holds a demo program, 'SWR2', which moves a hi-res screen between sideways RAM and screen memory. This technique could be profitably explored for animation effects and the like.

The system is straightforward to install. The RAM card itself lies perpendicular to the main board, rather like Apple expansion boards. Being flush against the right-hand side of the computer casing, it gives an end result that is neat and uncluttered. I imagine that the system is less prone to overheating, a problem which can apparently beset those boards which lie parallel to the Beeb's circuit board. Certainly, during testing no overheating problems manifested themselves.

Initially, I was not happy with the need to plug the two flying leads into the CPU socket. To quote the instructions, it is 'quite simple, although a little unprofessional'. On the other hand, it does mean that no soldering is required to install the system. To minimise problems caused by hole enlargement, I inserted an extra IC socket into the CPU's socket before replacing the CPU and two extra wires. I would recommend users to do likewise. Unfortunately, there is no space to add an extra IC socket underneath the cartridge base (I tried it: the case wouldn't shut).

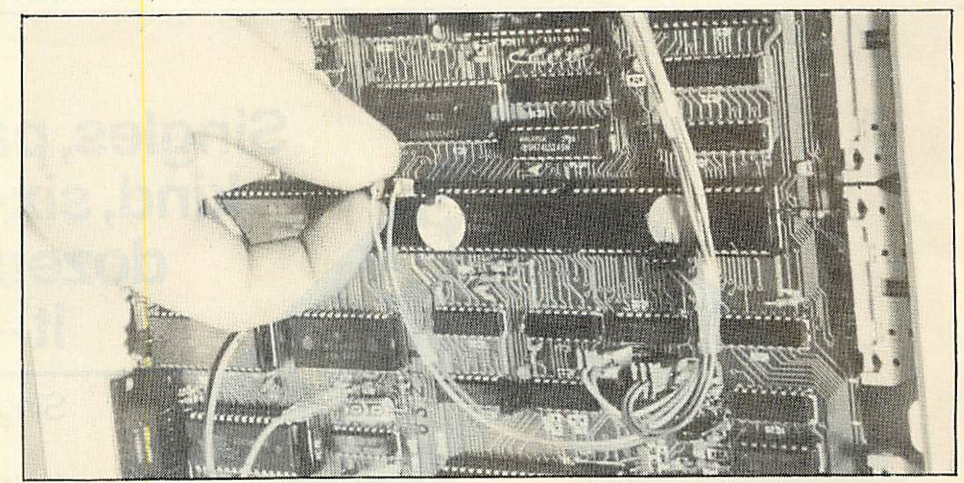
Disc users are, of course, most likely to benefit from the sideways RAM, having both the utilities disc, and fast access times at their disposal. However, there is no technical reason why a tape-based BBC could not be used, providing one is willing to put up with longer loading and saving times.

My overall impression of the system was very favourable. At £35, including VAT, the sideways RAM system offers very good value for money. Its versatility, and relative ease of use, should make it a worthwhile choice for those wishing to enhance their Beeb's potential in a number of exciting directions.

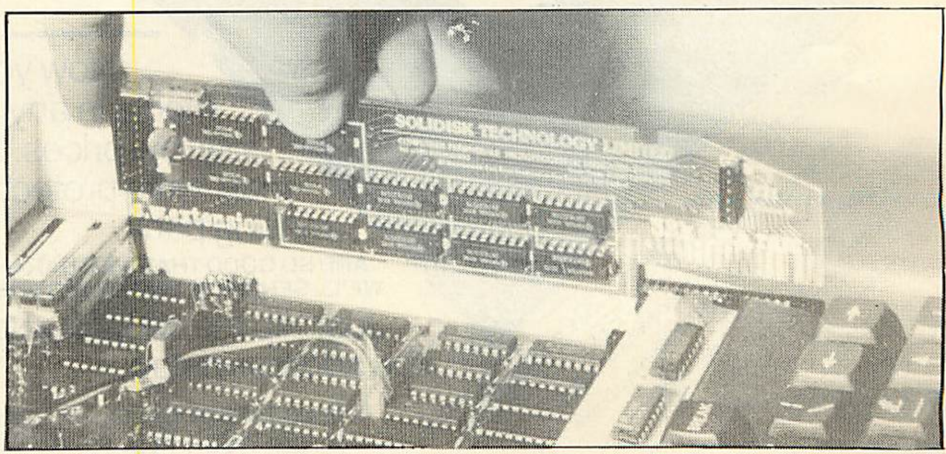
Vincent Fojut

```
  10 REM PUT MACHINE CODE IN S.W.RAM
  20 FOR PASS = 0 TO 2
  30 P%=&8000
  40 [ OPT PASS
  50 LDA #2
  60 DEX
  70 RTS
  80 ]
  90 NEXT
 100 END
>RUN
8000
8000 A9 02      OPT PASS
8002 CA         LDA #2
8003 60         DEX
                RTS
```

Listing 1. Saving machine code in sideways RAM. Though hex values listed are incorrect, the correct machine code is saved in sideways RAM at &8000 onwards.



Solder or push the two pins Write and Phase 2 down to the same holes as the 6502 pins.



Replace the ROM cartridge by the sideways RAM Card – notice the two RAM ICs on the left which occupy position F (or 15). If an SWR 32 is installed there will be two extra RAM ICs in position E (14).

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HARD AND FAST MINI DRIVE FROM HITACHI

Hitachi Twin Disc Microdrive System, available by mail order only from Advanced Memory Systems Ltd, Woodside Technology Centre, Green Lane, Appleton, Warrington, Cheshire WA4 5NG.

THE Hitachi 3-inch disc microdrive from Advanced Memory Systems is the latest in the increasing range of innovative add-ons being marketed for the BBC micro. It certainly is a *micro* drive system, measuring just 175 × 190 × 50mm, which makes it comparable in size to the usual type of computer cassette recorder – and this is the twin drive!

Opening the ample packaging reveals a host of goodies that normally have to be bought as extras, such as cables, manuals, utility EPROM and three discs – in fact everything you need to get yourself running. A quick look through the opening pages of the manual shows concise setting up instructions and numerous schematic line drawings depicting each stage of the procedure very clearly.

The microdrives, which are 40-track, are enclosed within a steel case that has a textured finish that neatly matches the Beeb's case. The top of the case is attached to the base via four small screws, removal of which (not recommended) reveals two identical PCBs (one for each drive) that hold an incredible number of components, including what is presumably a 48-pin ULA. Two sets of DIL switches on each board allow the user to reconfigure each drive select number, if needed (ie, drive 0 can be configured as drive 1 and vice-versa), though it is important of course that only one drive of each number exists.

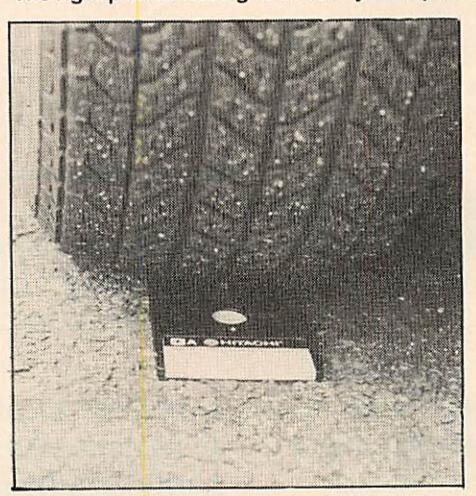
The boards sit atop the drive mechanism, which is directly driven from a brushless motor capable of a disc rotational speed of 300rpm. The read/write head is visible through a long hole in the PCB, through which it rises when the micro disc is removed. Seeing the compactness within the casing left me wondering whether overheating would be a problem. However, both rear and bottom plates contain ventilation slots and I encountered no problems after two weeks of intensive scrutiny.

Emerging from the rear of the case are the ribbon cable and the power lead with plug that fits into the Auxiliary Power Output port on the underside of the Beeb. These are simple to connect if you follow the manual's instruction. Single drives have readily accessible connectors so that upgrading to a second drive is a relatively painless matter, and because the AMS interface is standard this second drive could be a 5-inch version if necessary.

Each microdrive is numbered (0 and 1) and includes an illuminator at the top right-hand corner to indicate which side of the disc is in use (more on this later). The timings for the drives are impressive, with a track-to-track access time of just 3mS and an average access time of 55mS, offering a transfer rate of 125k per second.



'The rigid plastic casing is certainly childproof', says AMS



Disc drive: AMS claim that the Hitachi microdisc withstood being driven over at up to 60mph

The microdiscs themselves are also impressive and measure just 80mm wide (which is a little over 3 inches) by 100mm deep; and robust they certainly are! At no time is the disc proper exposed to the hostile world, being protected by a tough plastic casing which houses a metal shutter that retracts only as the microdisc is inserted into the drive. For me this feature is a big plus. Not being the tidiest of people, I find it most reassuring that I can take the disc out of the drive and just leave it on the top of the case.

The microdiscs also underwent an unscheduled benchtest at the Acorn User Show. During one evening a certain author (who shall remain nameless) unknowingly sat on one for several minutes as he was doing some jottings!

The microdrives are 40 track but may be used in double-density mode. Each disc has an unformatted capacity of 125k (250k double-density), reducing to 100k (200k) once formatted. The tracks are divided into 10 sectors of 256 bytes, giving a total of 2,560 bytes per track. Not so astounding, you may think, but the microdiscs are double-sided!

You can flip it over like an ordinary cassette tape and record on the other side, thereby giving you an effective 200k (400k) storage per disc!

The microdiscs are clearly marked at the end of sides A and B, so it is clear at any time which side of the disc is being used. However, the indicator light changes colour depending on which side is in use – green (though it looks more yellow to me) for side A and red for side B. A disc may be removed from the appropriate drive simply by pressing a large eject button at the base of the drive.

Either side of a microdisc may be write-protected by switching a small plastic tab at the 'front' end of the disc casing. The two associated tabs are placed on opposite edges of the disc and again are clearly marked A and B so no confusion can arise. Retracting the tab removes the write-protection.

Ready-pasted labels on the plastic disc case allow disc contents to be written onto

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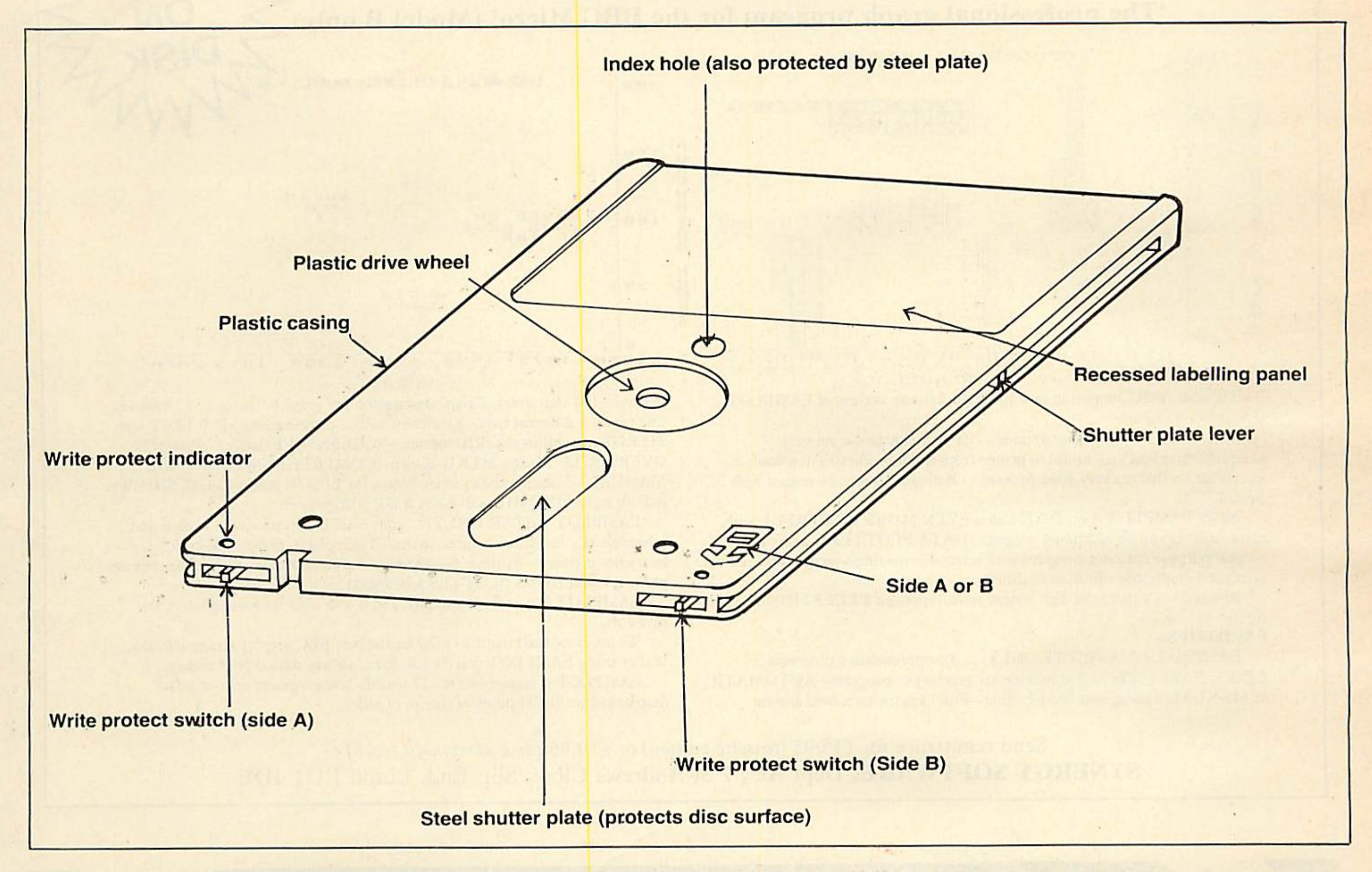


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with any type of pen without fear of damaging the disc.

The utility EPROM contains two commands, *FORMAT and *VERIFY. These are not present on the Acorn DFS but are included with other DFSs such as those marketed by Pace and Watford Electronics.

Fitting the chip into one of the sideways ROM sockets is made simple even for the novice following the instructions and diagrams in the manual.

On power-up a *HELP command reveals the message:

```
AMS UTILITIES
    format
    verify
```

These commands are now available for direct use from the keyboard, making it a breeze to format and verify new microdiscs. These two utility programs are also available on the three microdiscs supplied in the package, which also hold another program called '*MEMO*'. This demonstrates how various features of the DFS can be used to provide a list of reminders on power-up or pressing SHIFT-BREAK.

I maintain that you can get a good indication of whether the hardware item you are considering buying is good or not by having a look at the manual accompanying it. I see no reason for changing my mind in this instance, because the *AMS Disc System User Guide* is excellent. The spiral-bound volume consists of 80 pages printed on quality paper. The first two of the six chapters have already been described. Chapter 3 covers various aspects of the DFS such as Files, Directories and Libraries. Chapter 4 describes each of the DFS commands and their function; again, these are specific to the Acorn DFS but would probably apply to most others. Chapter 5, 'Machine Code and the DFS', not surprisingly, shows how the DFS can be accessed from machine code. Finally, chapter 6 provides useful technical information on the DFS and the microdrives.

The twin disc drive pack under review comes complete for £399 inc VAT (£225 for single drives), which is considerably cheaper than 5-inch drives offering similar facilities. The microdiscs may be purchased in packs of five and ten (£23.50 and £46) or separately for £4.95, which again makes them very competitive.

The microdrives and discs offer an exciting change from the present disc systems. No doubt they will face stiff competition. The outcome depends on the support given by the major software houses. I hope they take the initiative and start providing software on the microdisc, as I can highly recommend it to those thinking of buying a disc filing system.

Bruce Smith

AMS MICRODRIVE SPECIFICATION

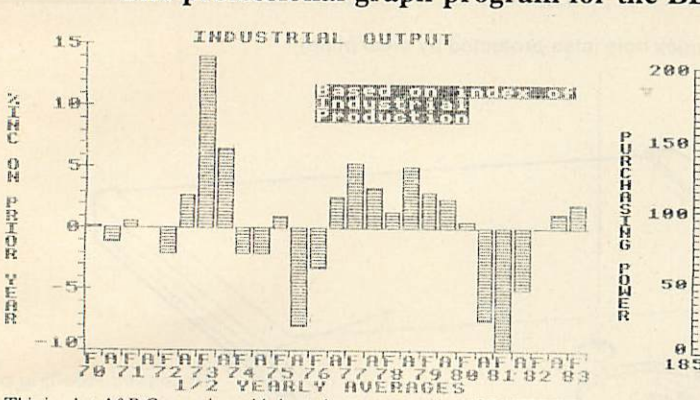
Item	Single-density	Double-density
Unformatted capacity	125k	250k
Formatted capacity	100k	200k
Sectors/track	10 of 256 bytes	10 of 512 bytes
Track density	100 tpi	
Disc rotational speed	300 rpm	
Average latency time	100mS	
Transfer rate	125k/sec	250k/sec
Average access time	55mS	
Track-to-track time	3mS	
Settling time	15mS	
Nominal power	3W7 (typ)	12W4 (max)
Soft error rate	10E9 bits	
Hard error rate	10E12 bits	
Seek error rate	10E6 seeks	

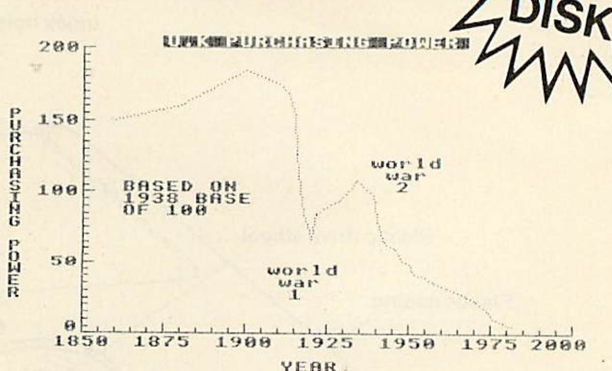
Dimensions
Single drive 155 × 95 × 50mm
Double drive 175 × 190 × 50mm

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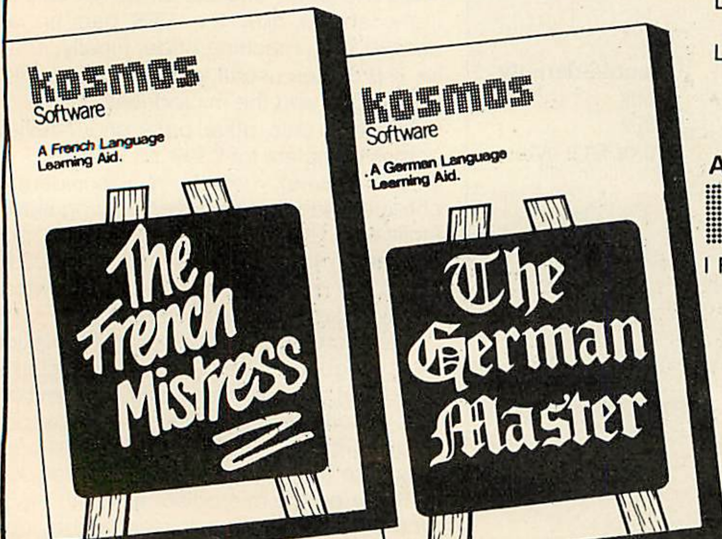
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COMPLETE DFS UPGRADE – OR DOUBLE TROUBLE?

Double-density disc controller board by Leasalink Viewdata, Scientific House, Bridge Street, Sandiacre, Nottingham NG10 5BA (0602 394000), £90.85.

THE Leasalink double-density disc drive controller kit comes as a complete DFS upgrade, along with the add-on board, a floppy disk (40 and 80 track) containing a formatter and disk verify utility, and a few sheets of instructions. The board, like some of the ROM expansion boards, rests on the sockets used by the 6522 in IC3 and the 8271 near the left-hand centre of the board.

Whatever current DFS is in use will have to be replaced by a new DFS ROM, which seems to be fairly Acorn-compatible, with no extra facilities like some of the later commercially produced DFS ROMs about.

There is little to fault in the design of the D/D board, which is clean and solidly made, unlike some of the thin, flexible add-on boards currently available. To fit the board, the instructions require that the user should remove the 8271 and the 6522 from sockets 78 and 3 respectively, bend back the power connections around where the board will fit, and then insert the board into the vacated sockets. I followed this procedure until it became evident that if I went on I would end up with a cracked motherboard. In the end, I had to remove the whole motherboard and press in the D/D board from both sides. The add-on board measures about 6 by 5 inches and will reduce the space available on the motherboard for other add-on boards. The DFS ROM, as mentioned, also needed to be exchanged with an 8k EPROM holding the LVL DFS.

The D/D board utilises the 1797 FDC chip, though room has been left on it to accommodate the old 8271 that it is replacing. The reason will become clearer later on.

Though having double-density usually means expanding the capacity of a disc by only 80%, I was rather surprised when after running the formatter routine, I found that I actually had fewer sectors available on the disc than if I had used the normal formatter. After a quick peek in the LVL formatter, it would appear to cater only for 40-track disc drives, allowing a maximum of 720 sectors in double-density, whereas a normal single-density 80-track drive will have 800 sectors available, less two for the DFS directory.

Even after amending the formatter, the most number of sectors I can safely obtain in D/D mode for an 80-track drive is 1,024, rather fewer than the 1,440 sectors I was expecting – in fact, less by the capacity of a whole normal 40-track drive. The reason for this anomaly is that the LVL DFS, in maintaining Acorn compatibility, has allowed only 10 bits (as Acorn had) to hold the sector count on the disc, thereby limiting the capacity of the DFS.

Switching between double and single density is extremely simple: an extension of the *DRIVE command allows the user to state either 'S' or 'D' to select the density. There is one little problem in that if you swap a lot of discs in and out, you may lose track of which discs are in D/D format. Putting a single-density disc in a drive expecting D/D will cause a rather nasty disc error message.

There is no command to check which type of density is in use.

Interestingly, when coldstarting the machine from a shift-break, the LVL DFS expects a S/D disc in drive 0, failing which it will adjust itself automatically to expect a D/D disc.

I'm not certain why this feature is not included for all the drives to save the user having to keep tabs on what type of disc he is using. After all, some of the other DFS systems allow the user to use both 31-file Acorn and 62-file non-Acorn disc directories without any help from the user.

After selecting either single or double density, it should be noted that it is the entire disc unit that goes into S/D or D/D mode, so if you have a double-sided unit, selecting the density for a side will cause the other side to enter into the same density mode. This can create difficulties when attempting to transfer data from different-density discs if you have only one drive.

Most of disc software tested with the LVL board worked without problems. However, any software addressing the old 8271 controller will not work at all. This includes the old formatters and some of the protected discs, including one with my son's favourite graphics program.

One of the claims made in the LVL advertisements is that their D/D system will accommodate up to 248 files. This is patently not true of the one that I have. A letter in response to my query says that LVL intends to achieve this number of files by increasing the number of logical drives, ie, a D/D side on a disc will hold two logical sides, thus allowing the user to access eight rather than four drives as at present. The letter also admits that there is no compatibility with any software addressing the 8271 and the new 1797 FDC chip, but LVL have allowed a socket on the D/D board for the 8271 and a provision will be made in the future for the option of using either controller.

Another enhancement from LVL will eventually give the user up to 248 files per side regardless of track density but no date has been given for the delivery of any of these upgrades.

Another area which the company claims to be looking into is documentation. No details were supplied with the D/D kit on the differences between the 1797 and the 8271 controllers. There was also no mention of whether existing DFS owners can be supplied with just the add-on board and LVL DFS and utilities, instead of the whole upgrade kit again.

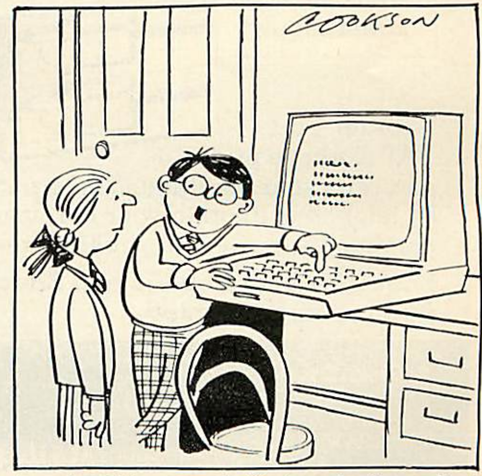
Users of the alternative DFS systems will probably have to sacrifice some of their convenient ROM-based utilities unless LVL include them into the new release of the LVL DFS.

Also, the user should check that his or her most important disc-based software is controller-independent before fitting the D/D board, at least until LVL release details of how to switch between the new and old floppy disc controllers. The fitting of the board itself may also pose problems for those users with no technical inclination and also for those who have existing add-on boards that overlap the area occupied by the D/D board on the Beeb motherboard.

I must admit that I had considered returning the whole kit to LVL and asking for a refund, as some of my more important software would not work with the D/D board. After a re-think, however, I decided to remove the kit from my machine for the time being and wait for LVL to announce the new releases of its software, which really do sound worthwhile (and which is something Acorn should have done in the first place).

Leasalink appear interested in providing these facilities, and the D/D board is a well-thought-out piece of hardware that unfortunately does not have the software to back it up.

It sounds like the typical computer rush job, and though 40-track owners will benefit from the increased capacity of the D/D kit almost immediately, I recommend that 80-track owners wishing to upgrade hold on until LVL have finished the job. **C Chan**



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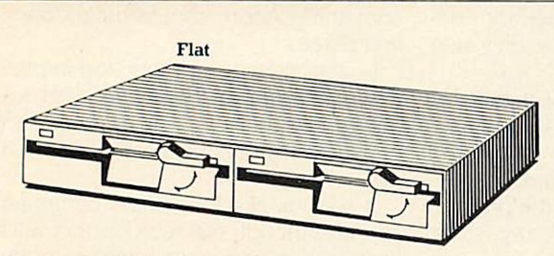
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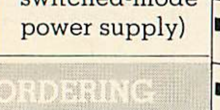
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THIS DOCTOR CURES MORE THAN DISC PROBLEMS

■ Disc Doctor EPROM utility, BBC B with discs, Computer Concepts, £33.

DISC Doctor is the neat but modest title for a utility EPROM from Computer Concepts. Neat, because most of the title will fit on to the chip label, modest because it hides several other useful routines on the chip which do not relate purely to disc activities.

Indeed, there are 20 different utility routines and it is hard to do justice to them all in a review; harder, in fact, than actually using them, which is for the most part a real pleasure.

Once installed, Disc Doctor announces itself on the cold-start screen. A resumé of the options is presented on a front page accessed with a *Help DISC DOCTOR command (see table 1), which can usually be abbreviated to *H.DI. This options list also includes notes on syntax for each command, a useful quick guide. All the routines are prefixed with '*' followed by the name, and can be accessed directly without referring to the front page.

In view of the variety available, I will group together facilities which have a similar purpose, beginning with those connected with disc use.

The starting point for any disc user is to format blank discs. The *FORM routine takes care of this, with several suprises. In common with most of the utilities, a number of parameters can be added to the initial command, some optional, some compulsory. As well as standard formatting, you can specify a limited number of tracks. The most exciting choice is to use a special format allowing 60 filenames per disc (anyone want to buy a redundant alternative DFS?).

*VERIFY is the logical next choice, again with the option to verify only designated tracks. Screen output from this and the format routine is in decimal format, a change from the usual hex. The only thing missing is the opportunity to repeat for batch formatting, but this is no real hardship.

Having put something on to your disc, you can 'look at' it with a pair of closely related options, *DSEARCH and *DZAP. The former allows the disc, or part of it, to be searched for a given string or byte. On a successful find, you fall through automatically into *DZAP, which allows the displayed sector to be edited. Make any changes and you are offered the choice of saving the altered sector back on to the disc. Inputs can be in ASCII, hex or decimal, with the TAB key being used to toggle. *DZAP can, of course, be entered directly.

The next pair of related commands is *RECOVER and *RESTORE. These allow specified tracks and sectors to be loaded into a chosen area of memory and saved directly on to disc, ignoring the DFS and catalogue. Computer Concepts comments in the instruction manual: 'Not recommended as common practice'. Well, maybe not, but it certainly raises some interesting ideas about software protection.

```
DISC DOCTOR 1.07

DIS (<sta>) (<end>) (<ofs>)

DISCTAPE <afsp> (<afsp>)...

DOWNLOAD <fsp> (<adr>)

DSEARCH <str> <trk> (<trk><sct><drv>)

DZAP (<trk>) (<trk><sct><drv>)

EDIT (<key no.>)

FIND <str>

FORM <drv> <no. trks> (<stt>) (<S>)

JOIN <fsp> <afsp> (<afsp>)...

MENU (<drv>)

MOVE (<dest page>) (<src page>)

MSEARCH <str> (<adr>)

MZAP (<adr>)

PARTLOAD <fsp> <ofs> <ext> <adr>

RECOVER <trk> <sct> <sct> <adr> <drv>

RESTORE <trk> <sct> <sct> <adr> <drv>

SHIFT <scr> <dest> <ext>

SWAP (<drv>)

TAPEDISC (<fsp>)...

VERIFY (<drv>) (no. trks>) (<stt>)


OS 1.20
```

Table 1. Disc Doctors selection of 20 utility routines

No prizes for guessing what the twin routines *DISCTAPE and *TAPEDISC do. Enter *TAPEDISC and you can go for a cup of tea while all your tape programs are moved on to a disc, or you can specify chosen programs only as parameters. Well, that's the theory. In practice, I found one or two awkward programs which couldn't be handled like this – but to be fair such nasties are few and far between.

If you have formatted your discs with the special 60-file format, you will need to use *SWAP to alternate between the two catalogues. You will probably also want to make use of the *MENU facility, which presents the disc catalogue with an index letter. Press the appropriate letter and the program will be loaded and run, Basic or machine code. Actually, to make this work, special directories are used, '+' and '–' for Basic and machine code respectively and '=' as the directory for machine-code programs which are *RUN from a Basic header.

It would have been nice to see all the programs in alphabetical order on the menu and use of colour for the index letter. Finding the program you want in a disorderly list of 30 can be a bit tedious.

If, like me, you have a library of tape programs which are too long to run from disc, you can forget about all those Basic and assembler routines for moving programs down in memory. *DOWNLOAD will take care of this automatically. Incidentally, one of the best features of this and all the other utilities is not mentioned by Computer Concepts. This is the facility to include the utilities as lines in a Basic program. Take the case of a two-part program, the first of which will run at &1900 and the second won't. All you need is a routine such as:

200 PRINT"Press any key to continue":A=GET

210*DOWNLOAD"SECOND PROG" E00

*DOWNLOAD is actually a CHAIN command so – end of problem.

Last of the disc-related options are the routines which I have found the least useful: *JOIN and its partner *PARTLOAD.

The idea of *JOIN is that you can join together a group of separate files and put them under one name, the purpose presumably being to save catalogue space. The first problem is that Computer Concepts and Acorn seem to disagree about the meaning of the word 'file'. Page 7 of the official *Disc System User Guide* says: 'Files can have any information in them. Typical examples would be one of your programs . . .' Ah hum! *JOIN does not work on programs, only on 'files'.

Initially, the original files are not removed from the catalogue, so if saving catalogue space is the object, you will need to delete them. This leads us to the use of *PARTLOAD, a facility for loading only part of a file into memory. Trouble is, if you've deleted the originals, how are you going to know how much of the master file to load? I tackled Computer Concepts on this point and the answer was: 'We've provided the routine. How you use it is up to you.' These routines do work, but I suspect I shall not find much use for them.

Well, those are the disc utilities, so what's left? Quite a bit, including a nice disassembler (*DIS), which gives coloured output and such facilities as optional printout, conditional jumps, fast or slow scrolling – to name but a few.

*EDIT is a real bonus, allowing function key settings to be viewed and changed if required. This is particularly helpful in the Wordwise context, because the output converts back correctly all codes which use the double bar and other special characters.

The remaining five routines are all concerned with accessing memory. The first two, *MSEARCH and *MZAP, work in a

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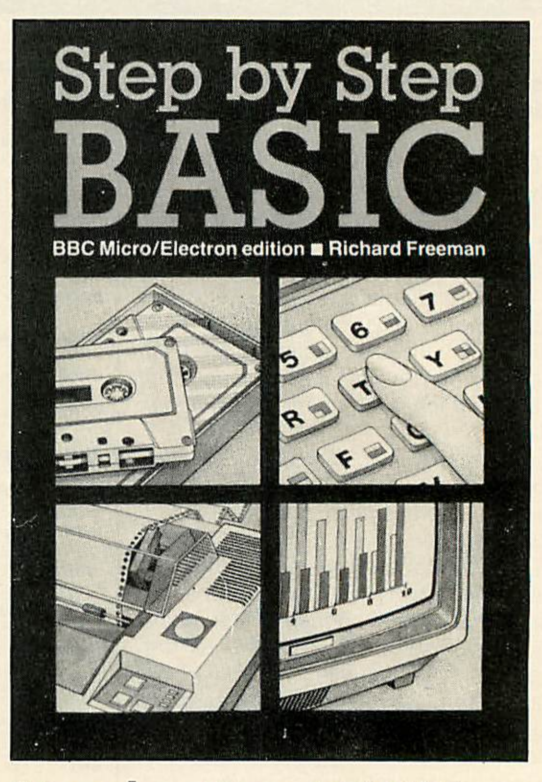
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PHILOSOPHICAL APPROACH TO OCTOPUSES

Philosopher's Quest, Acornsoft, BBC B, cassette £9.95, disc £11.50

I SHOULD have known it was going to be one of those days when the paint fell on me and the walls of the corridor squashed me flat.

It all began when *Philosopher's Quest* from Acornsoft materialised in my trusty micro and I foolishly stepped inside. This quest has had bands of adventurers throughout the country scratching their heads. The game is a standard text adventure type with no sound or graphics and the object is to find all the treasures scattered throughout the game.

The game comes with a postcard which can be used to obtain a clue if you admit you are beaten. It is a testament to the deviousness of the game that this has had to be abandoned in favour of a booklet of clues obtainable from Acornsoft.

Three large mazes dominate the game, one of them being a series of slides in which I have lost the seat of my trousers and my good humour. A nice touch is that certain traps operate in a different manner when visited for the second time. This is a good idea to incorporate when writing your own games, as with a little extra code you obtain two traps for the price of one.

The game accepts abbreviations of commands, and this can lead to disaster. I found BREATHE AQUALUNG was interpreted as BREAK AQUALUNG. It's not a nice feeling to see your life-support turning to fragments when you are 60 feet down and grappling with an octopus!

The final mixture of magic, solicitors and aqualungs may feel uncomfortable to some purists and I wish the few references to philosophers had been continued. Instead, the game forgets its title and becomes standard adventure, albeit full of different themes and trap types. It is certainly absorbing and provided I can get out of the whale's stomach before my right leg dissolves I'll try again to solve the mystery of the coloured stars. Then I'll hang up my sword. **Andy Mitchell**

ACORNSOFT GAMES
Philosopher's Quest
for the BBC Microcomputer Model B

FAMILIAR RING

Castle of Riddles, Acornsoft, BBC B, cassette £9.95

WHILE dusting out one of the dungeons I trod on a cassette that one of the dwarves must have dropped. On wiping off the bat's blood I found it to be Acornsoft's *Castle of Riddles*. A quick look round revealed no traps so I picked it up and flew (which is a clever trick if you know how) to my micro. Kicking an inquisitive minor demon out of the way I loaded up and prepared to do battle.

The quest, it appears, is to enter the castle of a sorcerer that has been taken over by his evil rival and return with the Ring of Power. I found myself outside the main gate of the castle with paths leading off round the back. Nothing ventured, I went straight in—wrong! Picking myself up I returned and finally entered the main courtyard where – surprise, surprise – the Ring is easily found. I grabbed it – wrong!

This is another great adventure from the Acornsoft stable. It has good atmosphere and a wealth of new traps. It also has a bug. Should you attempt to RUB something and foolishly forget to specify what you want to rub, you will receive a very interesting reply! Someone at Acorn must have got his head rubbed rather hard for that one.

The game has the additional incentive of a large prize for the first fearless hero to solve the final mystery, and I assume it was for this reason that the many mazes have been included. I hate mazes, but as these have novel solutions I will forgive Acornsoft. The game has a continuous storyline so I found it more exciting than earlier adventures from Acorn, and some of the traps have a nice touch of demonic humour.

For those sneaky individuals who can't resist the impulse to cheat I'm afraid Acorn's chief wizard has made this game almost 'bomb proof' – I've spent some time trying to wrest the secrets from the code and I'm not winning.

Like the Wishing Well bucket I'm now stuck in the mud beneath the castle. I only hope another adventurer comes along soon to help out as my lamp is going dim and that damn giant spider is still around here somewhere. **Andy Mitchell**

DISC DOCTOR UTILITIES

▶ page 141

similar way to the disc search and zap programs. *FIND is for use on Basic programs and will list all the line numbers in which a specified string of characters occurs.

*MOVE will move a Basic program in memory within page boundaries, whereas *SHIFT will move any section of memory of given length to a new destination.

All the Disc Doctor routines are easy to use, with a syntax which I found quite easy to learn. As an example of the usefulness I confess to an error in preparing this review. Using Wordwise, I accidentally pressed No.1 on the menu when wishing to re-load the almost finished article. Without looking, I entered the title and bingo! – one article saved as an empty file. Using a combination of *DZAP,*RECOVER and *RESTORE, I had my original file restored and running in under two minutes.

The slim, spiral-bound guide is clear and concise, with all the routines laid out in alphabetical order. Each item is fully described, with details of syntax and examples. At the back is a discussion on disc formats and a reference section showing commands and explanations of syntax abbreviations.

I have only a few grumbles. The *JOIN and *PARTLOAD commands would benefit from a bit more explanation on their use. The guide could also be clearer on what is meant by 'files'. Use of *DZAP produces occasional error messages on screen which are unexplained anywhere, either in the program or the manual.

One other problem is not really the fault of the Disc Doctor. Some of the commands can appear in identical form on other ROMs or EPROMs. Which one is obeyed will depend on the order in which you have inserted your chips, since the first chip which recognises the command will obey it. The DFS always gets first refusal, which means that if you happen to be using the Watford DFS then *EDIT will not give you what you expect. The Watford DFS also uses this command as a sector search routine, so you cannot use *EDIT from Disc Doctor.

With the steady growth in numbers of add-on chips, there is clearly a need for some sort of collaboration, but I wouldn't like to place bets on seeing it happen.

For the price, this must be one of the best value for money utilities on the market. I've picked out a few problems here and there but I would not like to be without it. It would make an ideal present for your wife or husband to give to you. **Terry Holden**

HULK PILLS AND THE DOCTOR

Escape from Moonbase Alpha, by Micro Power, BBC and Electron, £7.95

THIS is a 3-D graphical adventure set in a moonbase, where you have been left by your crew. You must use your skill to stay alive, collect bags of gold and find the doctor, who will let you make your escape.

First, instructions are loaded. These are extremely clear, leaving you in no doubt as to what your mission is or exactly what you are going to meet on the way there.

Once the main program has been loaded *Escape from Moonbase Alpha* starts. You are given the x, y, z co-ordinates of your room, along with your strength, gold supply and the number of 'hulk pills' you have left. If you are in the company of a monster, you are also told how strong it is, so that you may decide whether to run, fight or use a hulk pill. These make you turn green and increase your strength dramatically and you may walk through walls as well. However, these powers last only five seconds. To buy a pill you find a wizard and hand over a bag of gold. You use the keys Y, B, G and H to move, and P to pick up gold. T is used to take a hulk pill.

There are lots of interesting rooms and staircases in the moonbase. There are also many friendly and unfriendly creatures about: a wizard, a demon, Marvin the paranoid android, a metal mauler, a green grappler, deadly Doris (a TV set), the doctor (and his scarf). And, of course, there's the police box.

Graphically the game is very good. All the characters are well defined using multi-coloured graphics. The TV set is really excellent, and the rest are not far behind. A lot of the game's appeal derives from its graphics. The sound, too, is above average for an adventure game. A real effort has been put into the sound, and considering the few chances to use sound the programmer has done well.

The game hangs together very well and is great fun to play. It's a little fast for young children, though. **Stuart Menges**

BLOCK-BUSTER

Noc-a-bloc, Virgin Games, BBC B, £7.95

ANOTHER maze/moving-block type game. You're a little bird in a cold store being chased by ghost-like spods. You can kill these video nasties by squashing them with ice blocks or by stunning them (you and your hero push the edge of the play area) and then walking over them. If the three special encrusted star ice blocks are lined up during the course of the game you get a bonus. There are time penalties, too.

I found *Noc-a-bloc* coarser and much more sluggish than *Saloon Sally* and got the hang of it only by crossing my hands over the keyboard. The controls are A and Z for up and down; < and > for left and right (the instructions say the opposite, by the way). I was brought up on Z and X for left and right and : and / for up and down – I wish the software firms would get together and standardise. The game can, however, be played with a joystick.

Noc-a-bloc was written by Richard Bygrave. **Alan Pipes**

SQUARE MEAL

Cruncher, Virgin Games, BBC B, £7.95

CRUNCHER is a *Snake*-type game. You look like Dusty Bin and as you stomp around the screen you devour squares and create voids that can't be crossed, but there again you can't fall down them either. You can, however, scroll horizontal lines of squares across the screen – if you're clever enough – and wrap around the screen so that if you walk off the top you appear at the bottom.

The task is to get to the squares containing time bombs before they count down to zero. Avoid the skull and crossbone mines whatever you do and score bonuses by taking in the squares with golf flags. And all the time a big pair of 'bovver boots' is out to get you. These blue boots proliferate over the frames and are eventually joined by intelligent white ones. You can literally run rings round the blue ones – but oh those whites!

Nice sound effects – I like the pitter-patter of Dusty's shuffle. Otherwise, average. **Alan Pipes**

CHEMICAL ACTION

Chemiplant, H&H Software, BBC B, £7.50

THIS is one of those educational simulation games. You're ostensibly making a substance called Astod in a chemical plant. What you're really making, though, is money. You have to optimise the *Chemiplant* operation – don't make too much muckle, which fouls the place up, and convert as much expensive liquor as you can because customers pay only for the Astod you put in their tankers.

There are lots of variables to play with, like feed-rate and temperature, and alarms seem to be going off the whole time (the only graphics in the game are on the alarm board, which shows a plant diagram). Consultancy costs money, as does maintenance, so read the little handbook as many times as you can before the game starts.

This game is much better played in consortia (groups to you) and could last for ever. Next stop, chairmanship of ICI. **Alan Pipes**

TREASURE TREK

Colossal Adventure, by Level 9, BBC B, £9.90

THIS is an excellent adventure game. Byte for byte, *Colossal Adventure* was originally much longer, but not only have Level 9 shortened it to fit in a Beeb, they've added rooms. The original was well over 40k but sophisticated data-compressors have been used to cram more in. Now it is 6DFF blocks long, 1 byte below the bottom of the mode 7 screen. This program really does use all the Beeb's memory.

The idea of the game is to collect various pieces of treasure, such as a diamond and an emerald, and take them to a hut at a crossroads in the woods. Only when you have done this can you go to the endgame, where skeletons and fire await you.

There are a large number of difficult problems to be solved in the game and, fortunately, Level 9 supplies an SAE, so you can get a 'free clue'. You'll need it! But don't use it up too early – there's a lot of things you'll have to work out for yourself (how *do* you kill the serpent?). There are eggs that disappear, clams that aren't what they seem, a troll who demands a piece of treasure that you must have, two nasty mazes. . . .

To complete the game you must have a wide mind and be able to think logically. You will need to connect things which you have found with things you meet (what's the pentacle for?). You also have to read carefully what the computer says.

There are more than 200 scenes, and Level 9 have obviously put in a lot of work to write it, and there are a number of thoughtful and witty remarks in the text (it is a text-only game with no sound).

Colossal Adventure is one of the best in its class. I would recommend it to any adventurer. **Stuart Menges**

ELECTRON ON

Twenty-one Games for the Electron by James, Gee & Ewbank, Granada Publishing, 145 pages, £5.95.

THERE'S already a huge number of books around for the Electron, but where are the Electrons?

Twenty-one Games is a well-presented book of graphics games from these well-known authors. They point out at the beginning that it is 'not intended as just another collection of programs', but it can be used 'to further improve your own knowledge of Acorn Basic programming'. I would go along with their comments.

The games cover a broad spectrum with offerings such as *Word Scrabble, Positron Invaders, Capture the Quark, Electron Epsom* and *Fruit Machine*.

Each program is treated in similar vein. First a black-and-white photograph shows

Page 154▶

GET YOUR HANDS ON ONE...



The

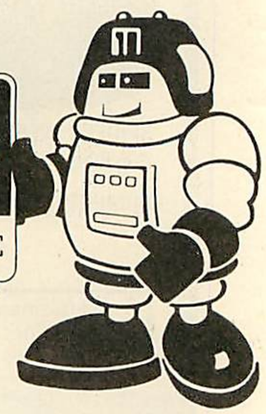
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...BEFORE THEY DO!

YOU AND YOUR LOVE LIFE – ALL IS REVEALED

'I Do' and The Dating Game, Acornsoft and Ivan Berg Software, cassette, £12.65 each

COMPUTER dating agencies have been around for some time now, but if Acornsoft have their way, your love life – or lack of it – will be sorted out on your BBC or Electron. *'I Do'* and *The Dating Game* are packages aimed at the adult market that claim to help you find a compatible partner and help bring down the divorce rate.

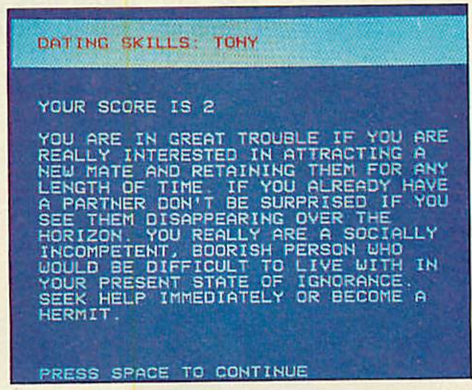
'I Do' is based on personality questionnaires developed by Hans Eysenck and is the more serious of the packages. It is aimed at couples who wish to assess and understand their relationship and individual personalities. The program announces itself with the wedding march theme and a title page proclaiming it to be 'your guide to a happy marriage'. A main menu is then presented, offering a choice of running the questionnaire or saving and retrieving results. Either one or two people can take part and the computer allows partners to answer together or separately.

The program consists of more than 400 questions, split into eight sections convering extrovertness, emotional stability, ego, marital satisfaction, social attitudes, feminist beliefs, masculinity/femininity, and sexual attitudes. The questions for each test are loaded separately and on completion of each a chart indicates your results on 11 compatibility scales. These questions are multiple-choice and your answers are not shown on the screen, thus remaining confidential. Which is just as well as they are quite explicit and demand absolute honesty if the results are to have any meaning.

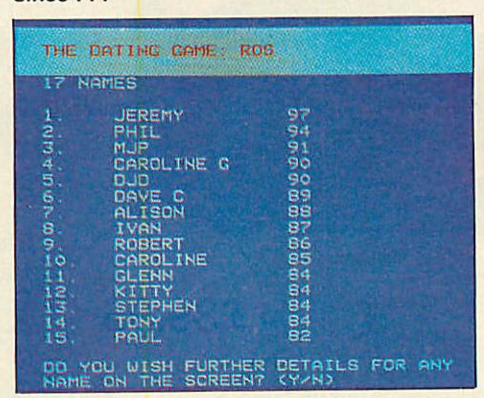
In contrast *The Dating Game* is quick to run and lighter in approach. The package actually consists of four programs: *Dating Game; Love Style; Preferred Relationship* and *Dating Skills*.

Developed by Dr Glenn Wilson, a colleague of Eysenck, the programs analyse different aspects of a person's character. Of the four, *Dating Game* was the most powerful and most fun. Up to 40 people can answer the questions – again multiple-choice – and then compatibility ratings, sexual and social, for any named person in relation to others on the list can be called up. I was delighted to learn that I had a 97% compatibility with a young lady from Ivan Berg Software, the company which created these packages. I did cheat – but then I'll do anything for love!

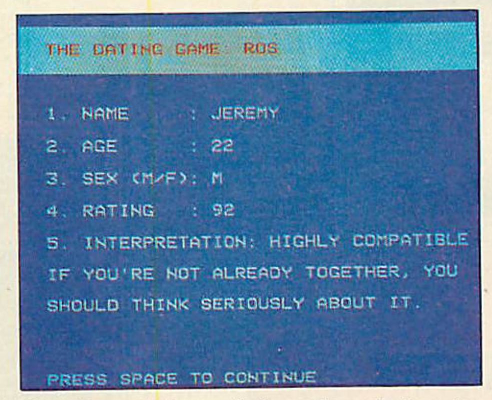
The other three programs investigate what kind of lover you are, your role within a relationship and your skills in dating and mating. As you'd expect *Dating Skills* has some of the funniest questions and answers. You could end up being assessed as 'socially incompetent' and advised to 'seek help or become a hermit'.



The 'Dating Skills' section of the 'The Dating Game' gives its verdict. Tony hasn't been out since . . .



Ros asks for Jeremy's credentials, and he gets a high sexual compatibility rating.

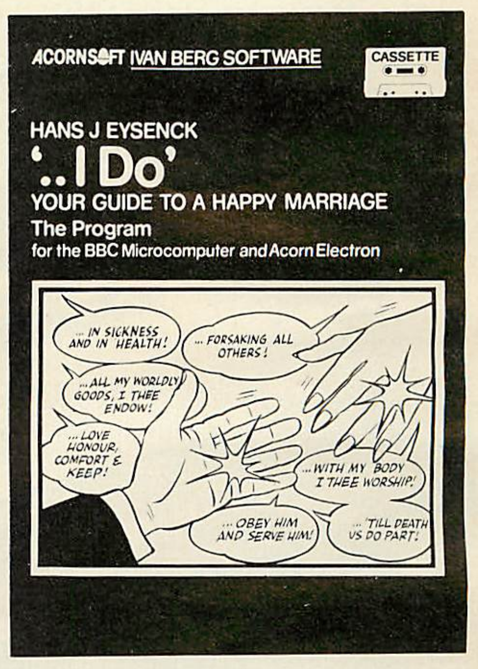


Now Ros wants a priority rating of all party-goers for general compatibility. It's that Jeremy again!

These packages are great fun and *The Dating Game* in particular is ideal for a party, though you could find yourself with a different partner at the end of the evening!

How serious are they? Well, all personality tests are limited by the questions asked, the replies allowed and the way they are interpreted. These questionnaires may reveal certain aspects of your lifestyle you weren't aware of, but don't let them govern your life.

There's another aspect to these packages. It is noticeable (and commendable) that this software appeals equally to both sexes.



'I Do' and *The Dating Game* are provided on cassette with an accompanying booklet. I reviewed these programs on disc and I suspect that loading the programs from tape could be tedious owing to the large database. They are well worth the effort, though, as they are very funny (sorry – I can't take them seriously). **Jeremy Vine**

TURN THE TABLES

Saloon Sally, Psion Software, BBC B, £7.95

IT TAKES a lot to amuse a jaded software reviewer, I can tell you. But *Saloon Sally* is a game I play for fun, and that's some recommendation. It has the simplicity and compulsion of a Pacman-type game – there are just five controls: up and down (: and /), left and right (Z and X), and kick (space bar).

Sally has to collect gold bars from tables arranged in a maze. To do this she kicks the tables aside and takes the gold by walking into it. She's pursued by four mean cowboys who negotiate the table maze and stomp all over our heroine when they catch her. Sally can box in the cowboys by judiciously arranging the kicked tables, or stun them by aiming a flying table at them – if she stuns all four you get a bonus. But now and then the lights go out (the cowboys turn blue) and the cowpokes bust through the tables. Sally can disintegrate tables that don't contain gold bars, but this tends to slow her down. And in the tradition of film westerns, the pianist just keeps on a-playin'!

Highly addictive. In fact, I think I'll just try to beat my high score. Then I'll stop, I promise, and write a few more reviews.

Alan Pipes



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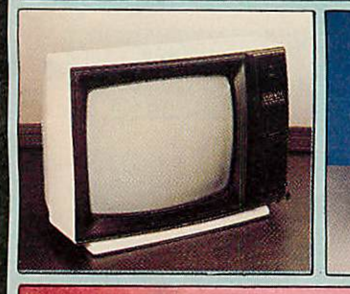
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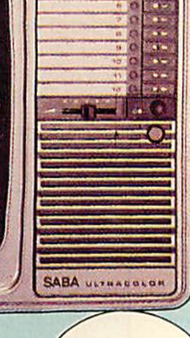




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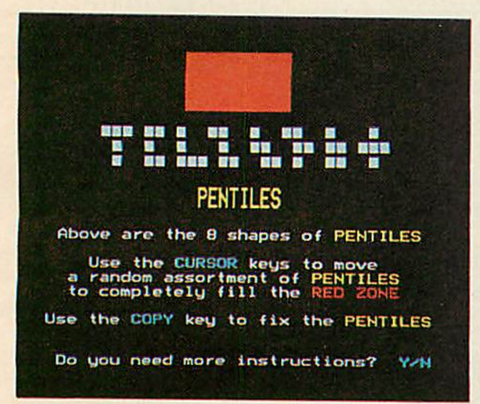
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'A game for the family requiring skill, logic, memory and chance'

A NIGHT ON THE TILES

Pentiles by Silverlind, BBC B, £6.95, cassette.

FED UP with banging your fingers frantically on your Beeb keyboard until they're numb? If so, you might find this excellent piece of software a pleasant and most relaxing change.

The object of the game *Pentiles* is to completely cover a red target area of a grid of squares with a series of Pentiles. What's a Pentile? I hear you ask. It's a series of five pixels joined to form a variety of shapes, for example a T or a +. The target area size may be specified by selecting a depth of 3, 4, 5 or 6. As each target area is a constant 60 pixels in size, the width and length will vary accordingly. For example, selecting depth 3 will display a target area 20 pixels long and three deep. Depending on the skill level (1, 2 or 3) chosen you are offered either a single Pentile or a group of five from which to select one.

Once selected, the Pentile may be rotated through 90 degree intervals by pressing the 'Y' key until the desired orientation is arrived at, at which point the 'N' key is pressed. The Pentile can now be moved and fixed on the target area using the cursor control keys. Press the Copy key and the Pentile changes colour from white to yellow. Once a Pentile is fixed it effectively becomes out-of-bounds to other Pentiles, which can only move around it, not over it. The game is finished when you have completely covered the target area (not so easy), when fixed Pentiles obstruct your path and you cannot fix any more, or you have exhausted your Pentile supply.

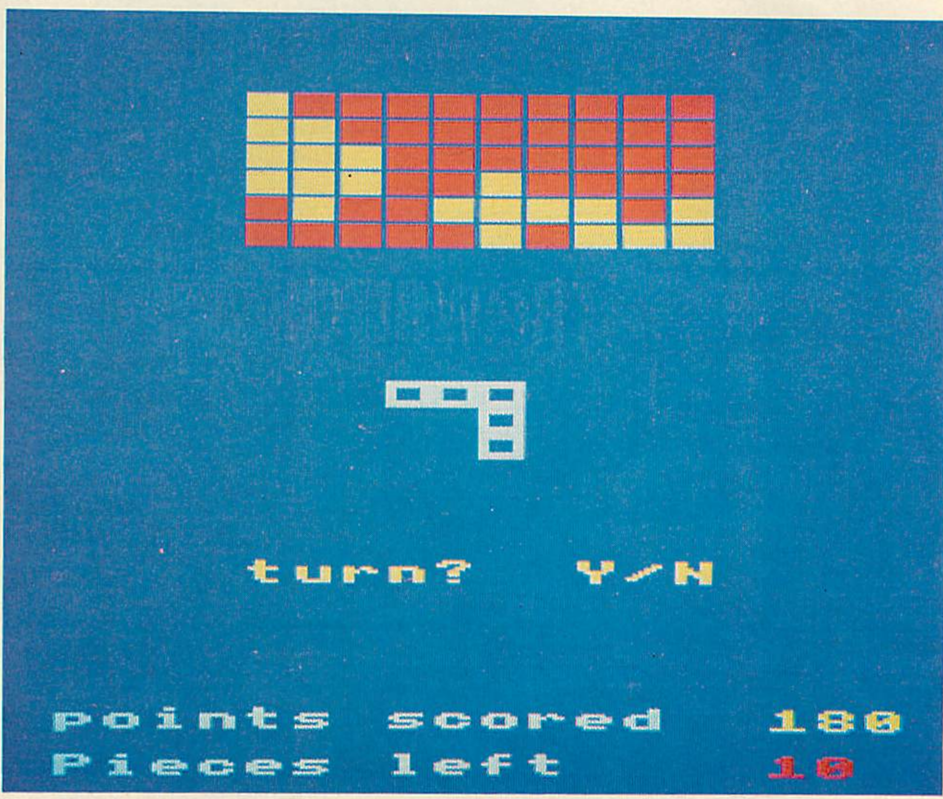
Scoring is simple. Each Pentile has a fixed value ranging from 10 to 100 points, determined by the thickness of the Pentile walls, and its value is added to your running total as you fix it. If you fix the Pentile entirely within the target area you get a further five points; and other points are added – or deducted – according to how long you take to complete the game, and the number you leave unfixed.

Pentiles is written in Basic and played on a mode 5 screen. The graphics and colour, though simple, are pleasing and very good use of the sound facilities is made throughout the whole game (they can also be turned off).

The cassette insert describes *Pentiles* as 'A game for the family requiring skill, logic, memory and chance'.

I admit to being addicted to the game now, as I find it a good way of unwinding at the end of the day. I suggest you leave the invaders alone for a while and buy a copy of this.

Bruce Smith



Move the tiles into position with the cursor key, hit Copy and they turn yellow

AVOID ALPHOIDS

Free Fall, Acornsoft, BBC B, £9.95

FREE FALL is not, as its name suggests, a simulation of a parachute drop, but a game of survival in space. Your space station has been attacked by Alphoids who have injected the air supplies with cyanide. Only one member of the crew managed to don his space suit in time and your task is to keep him alive as long as possible.

To survive, the crewman must destroy the Alphoids but, having no weapons, our hero can only kill them by punching, kicking or ramming them. To do this, you control the air-jets attached to his suit and move his arms and legs. Sounds simple, but the Alphoids appear as four different types: Craboids, Lobstoids, Bastoids and Waspoids. Between them they have the power to bite through the space suit and inject a nerve toxin into the blood, breathe fire and catch and throw bombs. If you are lucky enough to catch a bomb you can throw it at them.

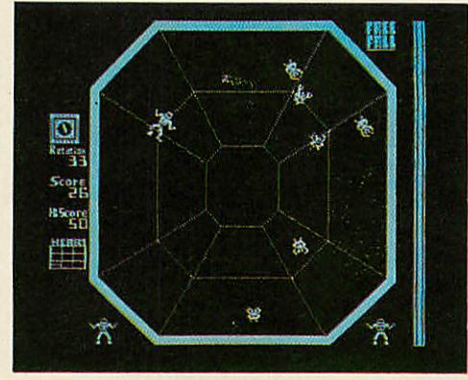
The space station is represented as a large octagon on the screen display. Other on-screen information includes the rotation rate of the station, which increases with the score; an air supply meter and a heartbeat monitor. The heartbeat increases when the crewman is bitten and emits an appropriate blip-like sound.

The display is black and white as it uses the high resolution mode, and character definition is good. The crewman is controlled by eight keys (or by joystick) and this is the most awkward part of the game. Considering the number of controls involved, the key layout is well thought out but it takes some getting used to, and I found it tempting to propel the crewman at the Alphoids using only the air-jets.

An extra life is awarded after 100 points and every 200 thereafter.

Free Fall is, like most Acornsoft games, technically good and represents a novel approach to 'alien lifeform' games. It certainly provided me with a few hours of fun.

Jeremy Vine



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THE MICRO AS TUTOR

Learning and Teaching with Computers: Artificial Intelligence in Education, by Tim O'Shea and John Self, Harvester Press, Brighton, £6.95, paperback, 307 pages.

THE 1992 version of today's £500 microcomputer will, by present standards, be an extremely powerful machine, with 1 million bytes of main memory. By then, most of the educational software marketed for the current breed of microcomputer will appear rather simple-minded.

In fact, authors Tim O'Shea and John Self say little about existing commercial software, but what they do say is uncomplimentary. It is described as being of poor quality, based upon impoverished theories of learning, reflecting little programming skill, and standardised on outdated technology. If we deduce from the programs now flooding the educational market that writing software will remain a spare-time activity then we are mistaken, for computer-aided learning (CAL) systems will increasingly be based on artificial intelligence.

The book traces a general trend in the evolution of CAL away from rigid computer-oriented approaches towards sensitive learner-oriented ones. Various lines of development are described and evaluated and their limitations discussed. Thus, although linear programs, branching programs and simulations have merits, they are seen as making an uninspired, marginal contribution to education.

Approaches based upon generative CAL and mathematical models of learning presuppose well-structured subject matters and suitable learning models. The languages Ticcit and Plato misplacedly emphasised technology, and failed to solve the problems of producing worthwhile teaching materials. Only two approaches, problem-solving and dialogue systems, are seen as likely to enhance the educational process radically, mainly because these approaches do not have clear limitations.

Problem-solving regards the computer as a tool for developing students' problem-solving skills. This is the Piagetian approach exemplified by Logo. The authors think it likely that further languages and environments will be developed, and that these will reflect children's cognitive growth. We will certainly hear more about Smalltalk, a set of object-oriented tools, which at present requires considerable computing facilities but which will be fully implemented on our 1992 microcomputer.

Also available will be expert dialogue systems which contain not only subject knowledge but also knowledge about the student being taught and about alternative teaching strategies. These systems will be capable of holding intelligent tutorial dialogues. Within certain domains, such as symbolic integration and bacterial infections of the blood, dialogues that compare well with those of author-language programs have already been achieved. However, the book does not avoid discussing some of the state-of-the-art difficulties with these systems.

Clearly, it is unlikely that teachers will write large problem-solving and dialogue systems themselves, and in any case O'Shea and Self suggest that, as far as schools are concerned, computers will not mimic other teaching processes but will more likely be used to provide programming environments and educational games. It could be argued that it is in this area that the authors underestimate the contribution that can be made by the current educational computing scene in inventing and experimenting with different kinds of computer-based learning experiences. Nevertheless, the book presents a readable account of research and ideas in artificial intelligence likely to have considerable influence on future educational computing. It should be added to the list of essential reading for practitioners and researchers in CAL. **Robert Ward**

TON OF LISTINGS

One Hundred Programs for the BBC Microcomputer by John Gordon, Prentice Hall International & Acornsoft. Book, 209 pages, £6.95; cassette, £11.50.

THERE has been a proliferation of listing books for the BBC micro over the past year or so, many of which have been of very poor quality both in what they offer and the programming style they adopt. This book, despite its awesome title, is different, though, and stands head-and-shoulders above its contemporaries.

The 100 programs are grouped into ten sections: Introduction, Games, Business, At Home, Painting on the Screen, Data Handling, Recreation, The Science Lab, Mathematics, and Programs for the School. The programs are laid out in similar fashion, with an introduction and program description, the commands and responses required to get the program running, the listing itself, and in many instances a diagram or flowchart helps you to grasp the operation of the programs.

The listings look like printout reproductions but the quality is so good it is hard to tell. The programs are written to a very high standard and are good examples of how programs should be constructed, as they use the Beeb's facilities to the full. I mention two picked at random as a sample: the Conversion program (program 34) shows how versatile a single program can be, allowing any one of 17 conversions to be performed (for example, inches to centimetres and atmospheres to cm Hg); and Spelling (program 99), which shows how a general database can be built up to test and correct children's (or adults') spelling, either in sentences or as part of a general tutorial.

A cassette tape of the same name has been produced with the book, on which all programs are included. Accompanying the tape package is a 32-page booklet with brief details on each program, so the tape can be bought as a free-standing item.

If you want to learn how to program correctly from program examples you could do no better than buy either the book or the cassette.

Model A owners will be interested to learn that all but eight of the programs will run on their machine. **Bruce Smith**

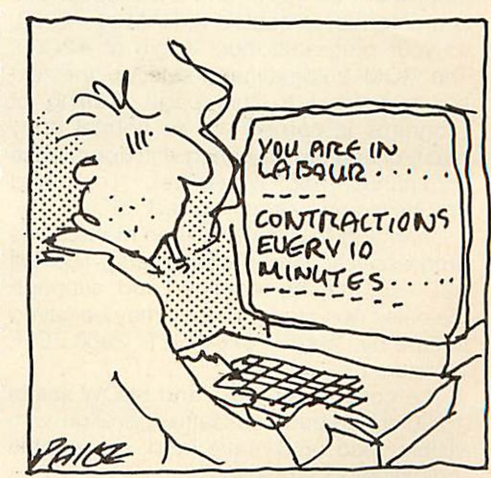
GOSUB CRAZY

Sixty programs for the BBC Micro by Erskine, Walwyn, Stanley & Bews, Pan Books, 288 pages, £4.95.

THIS book, *Sixty Programs for the BBC Micro*, is the latest in an increasingly large selection of books from the *Personal Computer News* Library. As you may have guessed, it is explicitly a book of listings, some of which seem to have been adapted from other micros to work on the beloved Beeb. For this reason many of them are poor programming examples as they fail to make adequate use of BBC Basic. I cannot, for instance, understand why anyone would persist in using GOSUBs in preference to PROCedures. One program uses three GOSUBs in the first five lines!

The programs are reproduced listings which, thankfully, are of very good quality, most of them being preceded with a dozen or so lines of introduction. The programs include 'arcade action games . . . tactical games . . . quizzes, tests of mental agility, party games and a leavening of utility and educational programs'. Seventeen of the programs will run on a model A machine.

Not one of my favourites, though I'm sure the insomniacs among you will find it of some use. **Bruce Smith**



HOW TO GIVE YOUR OLD ATOM A GRAPHICS BOOST

Atom Screen ROM, from Alan Knowles, 15 Belgrave Avenue, Flixton, Manchester (061-748 4507), £10.

IN MY article 'Where do we go from here?' (October issue) I mentioned the availability of a screen ROM from Procyon. Due to factors beyond their control, Procyon will not be marketing this ROM, but it is now available from its creator, Alan Knowles, an occasional contributor to *Acorn User*.

This Atom Screen ROM comes as a 4k EPROM, with a 4-page set of printed instructions and two demonstration programs (in listing form). It is based on an original program ('Softscreen'), published as a cassette about two years ago by Computer Concepts. It is made available with the full knowledge and consent of CC, and Alan has considerably improved and added to the original.

It aims to provide some of the graphic facilities missing from the older machines, such as mixed text and graphics and text 'windowing'. These facilities are enabled by the use of additional control codes and have been arranged to be as compatible as possible with those of the BBC micro. Table 1 shows the full range of codes and their action. Some may be used in direct mode, by pressing CTRL and another key. When used in this manner, action is immediate and the code is not passed down the input channel. In this way, pressing, for example, CTRL-G will not produce its usual error message. The use of code 1 will be a welcome inclusion for those of you with printers.

The ROM may be activated with or without the FPROM fitted; without it you must LINK to the appropriate routine. With FP the commands COLD or WARM initialise the ROM and the screen clears to mode 4, in normal text mode. This gives you a text size of 24 lines × 32 characters, white on black. All ASCII codes are generated, with true upper and lower case. The character set is booted to RAM at #2900, so your programs must begin at #2C00. The ROM automatically sets up the text space pointer to this page. Editing of programs is carried out as normal (they must, of course, be written with upper case commands and variables). Text and graphics may be freely mixed.

Changing to a lower screen mode gives progressively larger characters. The full ASCII set may be redefined and, although the notes don't tell you, they may be saved to tape by: *SAVE "CHARSET" 2900 ZBFF for future use.

The commands FAST and SLOW select 1,200 or 300 baud cassette operation, with visible load and save and an audible indication of completion.

All keys auto-repeat and pressing the REPT key induces superfast auto-repeat. In addition, pressing CTRL and the space-bar simultaneously stops output at the start of the next Basic line, allowing a pause, or you may enter control characters, which are acted upon but not set to the input stream – an extremely useful facility. This function has a 'toggle' action.

Again, although the notes don't tell you, these facilities are available on power-up, with the FPROM fitted, so you may use them in mode 0/text.

Strictly speaking, this ROM is not compatible with either the BBC board or the colour board. However, a bit of thought will enable you to redefine the characters for colour mode printing (effectively a 4 × 8 pixel matrix) and, since the default character set is held in ROM (ASCII order, from #A00A), this can be accessed from the BBC board using a program such as the one recently given for Wordpack in 'Atom Forum'.

A great deal of effort has gone into making the ROM crashproof. Unrecognised codes are output as a space and invalid control codes are ignored. The only way I've found to crash is to select mode 0 (with the P.$22 option).

The two demonstration listings illustrate, first, a series of overlapping and inverting text windows (shades of Lisa!) and, second, how the character set may be manipulated to print sideways, or even upside-down.

The ROM extends the Atom in a useful way – it will make converting BBC listing a lot easier, for a start.

Barry Pickles

Code	Control key	Action	
0	—	Does nothing	
1	—	Send next character to printer only	
2	B	As normal	STX
3	C	As normal	ETX
4	D	Select normal text (32 chars per line)	
5	E	Select compressed text (42 chars per line)	
6	F	As normal	ACK
7	G	As normal	BEL
8	H	As normal	BS
9	I	As normal	TAB
10	J	As normal	LF
11	K	As normal	VT
12	L	Clear current window; home cursor to start of window; white on black printing	FF
13	M	As normal	CR
14	N	Page mode on. Screen does not scroll and new page prints from top of screen	
15	O	Page mode off; normal scrolling	
17	Q	Invert current text window and character set	
18	R	Invert whole screen and character set	
19	S	Clear whole screen to black; white on black printing; cursor and window size unaffected	
20	T	Invert character set only	
21	U	As normal	NAK
22	—	Following byte selects screen mode	
23	—	Redefine character. First byte selects character to be redefined; following eight bytes define new character	
24	X	As normal	CAN
26	Z	Reset window to full screen size	
27	—	As normal	ESC
28	—	Define text window. Four bytes following are parameters	
30	I	Home cursor within current text window	
31	—	Position cursor. Following two bytes are x,y position related to current text window and print size	
127		As normal	DEL

Table 1. Control codes

ELECTRON ON

► Page 144

the display you can expect to see on running it. A general introduction is followed by details of 'How to Play', outlining the responses required from the player. 'Typing Tips' points out where keying-in errors are likely to occur. A program's structure is analysed and attention drawn to the main subroutine areas. In many instances the programming details are followed by a section on 'Scope for Alteration'.

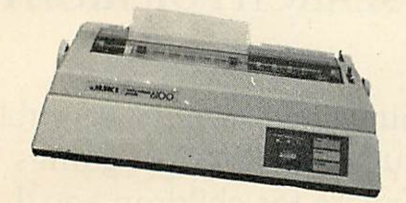
The listings are dot-matrix reproductions but remain legible and they are also sensibly laid out, being split across pages at procedural boundaries. They are also kept to sensible lengths.

A commendable production.

Bruce Smith

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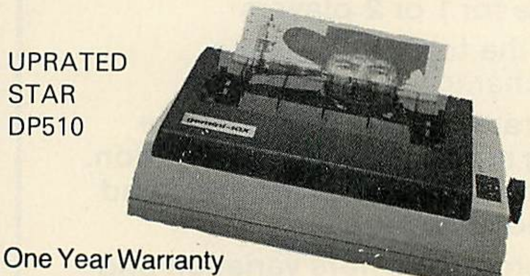
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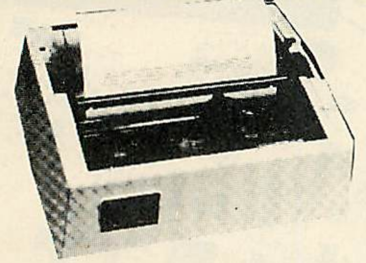
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MAGIC SQUARES

Dabble in this ancient and arcane art with Simon Dally and you could conjure up a software package free

GENERATING magic squares is an ancient pursuit that has occupied the time of just about everyone interested in mathematics. Examples have been found in Egyptian tombs, ancient Chinese literature and on the back of a pictorial representation of the 'cosmic tortoise' from Tibetan folklore. Plato referred to them in *The Republic*. Ninth-century Arab astrologers consulted them before casting their horoscopes and, nearer our own time, Benjamin Franklin wrote enthusiastically and knowledgeably about them.

The word 'magic' has stuck, probably because of the association with astrology, but even in our supposedly more clinical 20th century a learned tome about magic squares in my possession* has an introduction which declares: 'Magic squares are like a mirror which reflects the symmetry of the divine norm immanent (*sic*) in all things . . .'

Despite being of no practical use to anyone, magic squares have probably generated more books and articles than any other form of recreational mathematics and each year new titles get added to the list.

The basis of a magic square is that its rows, columns and two main diagonals all add up to the same. Thus in figure 1 – the simplest magic square of all – the number generated on all fronts (also known as the *summation* or magic constant) is 15. Figure 2 shows an even-celled magic square – a 4×4 square whose summation is 34.

There are two simple methods for generating odd-celled and even-celled magic squares. The following are the rules and you should be able to make your computer generate them for you.

ODD-NUMBERED CELLS

This method applies to any square with an odd number of cells, be it 3×3, 5×5, or 13×13. Figure 3 shows a 5×5 square in progress, into which we shall place all the numbers from 1 to 25.

1. In the central cell of the first row place a 1.
2. Move directly north-east, one square along and one above. Since this entails leaving the grid, place the 2 in the bottom square of the column you just left.
3. Again moving one along and one above, place the 3 in the relevant cell.
4. Perform the same action with the 4. Since this again takes you out of the grid you 'wrap around' and place it in the first cell of the row. The 5 can now be inserted to the north-east and the result is figure 3.
5. You have now completed entering the first group of five numbers (since this is a 5×5 grid – if it were 3×3 or 9×9 then you would carry on until the first 3 or 9 numbers had been entered) and you drop down one cell in the column to enter the 6.
6. Enter the next five digits following the same rules. Figure 4 shows the result after

8	1	6
3	5	7
4	9	2

Figure 1 (S=15)

1	12	7	14
8	13	2	11
10	3	16	5
15	6	9	4

Figure 2 (S=34)

		1		
	5			
4				
				3
			2	

Figure 3

		1	8	
	5	7		
4	6			
10				3
11			2	9

Figure 4

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

Figure 5 (S=65)

X			X
	X	X	
	X	X	
X			X

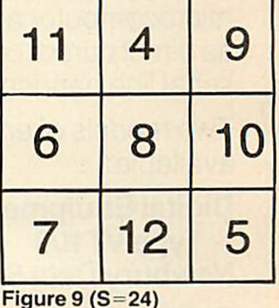
Figure 6

X	2	3	X
5	X	X	8
9	X	X	12
X	14	15	X

Figure 7

16	2	3	13
5	11	10	8
9	7	6	12
4	14	15	1

Figure 8 (S=34)



11	4	9
6	8	10
7	12	5

Figure 9 (S=24)

83	29	101
89	71	53
41	113	59

Figure 10 (S=213)

you've got to 11, and figure 5 shows the completed magic square.

EVEN-CELLED SQUARES

This method shows you how to generate a 4×4 magic square containing all the numbers from 1 to 16.

1. On a blank grid cross out both the main diagonals as shown in figure 6.
2. Beginning in the top left-hand corner, move along each row in turn and place the relevant number in all vacant cells. Where a cell has been crossed out, do not insert the number but continue to add one each time. Figure 7 shows the position after the first eight numbers have been inserted.
3. Now fill in all the crossed-out cells, again starting at the top left-hand corner, but this time beginning with the last number (in this case 16) and decreasing the count by one each time. Where a cell already contains a number, skip it as you skipped the crossed-out cells in step 2. The end result is figure 8.

There is no need for a magic square to begin with 1 or for all its cells to contain consecutive numbers. Figure 9 shows a 3×3 square which starts with 4, while figure 10 shows a magic square consisting of prime numbers only. Most of the research which goes into magic squares today consists of creating squares which not only conform to the basic rules but also have other interesting mathematical properties.

* *'Magic Squares and Cubes' by W S Andrews, Dover Publications*

17	225	93	232	81	92	21	62	145
124	250	162	115	198	102	135	23	116
216	310	33	200	153	189	170	171	95
261	87	210	297	76	38	75	63	174
50	132	100	68	248	58	125	69	66
105	184	85	150	19	126	29	270	42
138	34	243	46	168	186	264	279	25
190	84	155	152	57	290	31	108	51
99	54	230	114	165	207	27	136	330

UNRAVEL THIS JUMBLE

THIS month's competition: it is your sorry task to unravel the jumbled square.
The figures in the left-hand column and the top-right to bottom-left main diagonal are all in the correct position – the other figures may or may not be in the correct place but all appear somewhere in the box. Not only is this a magic square for addition, but also for multiplication.

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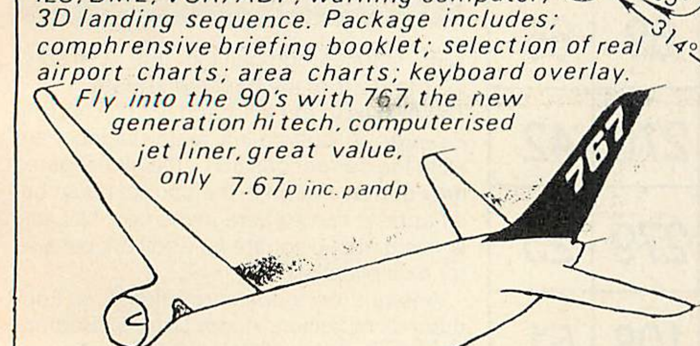
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Write to Peter Hughes at the above address to obtain details of his club and Monthly Magazine on disc, and this independent review of our software.

PIRACY AND PROTECTIONS

Sir, In the November issue of *Acorn User*, there is a letter about software piracy.

While obviously it is an undesirable thing, I think that the software houses themselves are mainly to blame for it. Most of the software available is of a quality which is not corresponding at all to the prices. Most prices seem to depend on the price of the original computer: ie, a BBC owner has to pay more than a Spectrum owner. There is also a lot of very bad software around, and the poor user finds that out after he has bought it.

I think game programs shouldn't have to cost more than £5. As the potential customers are mostly children, it is silly to expect them not to copy software as they have the time, the setup (schools etc) and the tendency not to pay for something if it can be avoided (especially if it involves spending £7-£10 per program!).

Secondly, a lot of software contains protections. Personally I don't buy any tape which I cannot run from disc (unless I can see that I can convert the program). In most cases the protections only prevent users from transferring their programs to disc and *not* copying the tapes.

As such it defeats the purpose and is only irritating if one has to update one's programs to run from disc.

A prime example is Superior Software, which must be using extremely expensive discs considering that they charge about £5 more for a 40-track disc!

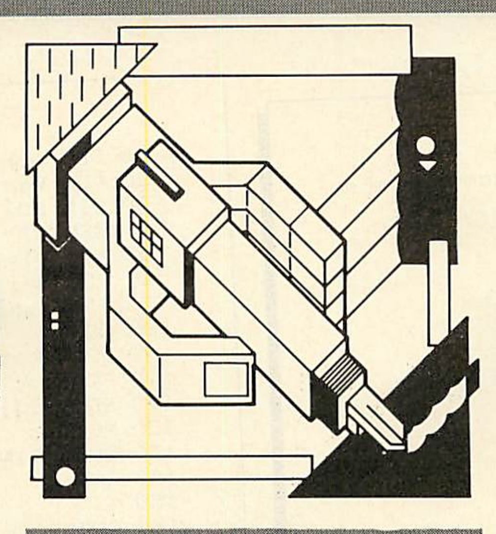
Another nuisance of protections is that no one guarantees the buyer that the software house is still existing when his tape/disc goes bad.

If a firm inserts protections, it should also realise that users may need replacements of their software for many years to come. With the market being what it is, who can guarantee that users will be able to get these replacements?

In the Free Ad columns one sees the many programs being offered at half price because obviously the owners have copied them. This is useless as one will only get reactions on special software (Lisp, Forth, View etc, but certainly not on *Snapper, Defender*, etc!).

Also people offering hundreds of programs from disc are obviously pirating! Can you not restrict these ads to prevent them being filled up with offers which no one is going to buy anyway?

K P W Rutgers
Bedfordshire



LASERBUG LIVES!

Sir, I understand that *Acorn User* have been receiving calls about *Laserbug* and why it is late appearing.

Due to various events, including production problems and illness, the past few issues of *Laserbug* have been rather late coming out. This has meant that we have been forced to produce a couple of 'double' issues, ie, the cover date showing two months instead of one. Although members of *Laserbug* join for six or 12 months, we use the issue numbers for reference, which means that a member who joined for six months will still get six issues and someone who joined for 12 months, 12 issues.

Although correspondence is taking rather longer to process than we would like, *Laserbug* is still 'in business' and going from strength to strength. We have recently started selling *Laserbug* in selected dealers – a wise move it would seem, as sales are going well. We are about to launch a full *Laserbug* software service following up on our competition in which a good program could win you a RGB monitor. We have just announced details of cut-price printers that members can obtain.

We have recently opened our pages to the new Acorn Electron. Our pages on Micronet 800 are still going strong. From the Christmas magazine onwards, *Laserbug* is likely to be taking on a slightly new style providing a much better balanced magazine with something for everybody.

So in short, *Laserbug* is still around. Our few problems should be over by the New Year and in 1984 we plan to keep on growing!

Paul Barbour
Editor
Laserbug

PLANETOID HIGH

Sir, I am writing in reference to Charles Painter's request for readers to send in their record score on Acornsoft's *Planetoid* (*Acorn User*, December).

My high score is 283,000, though I have heard of scores of up to 450,000.

My brother has scored 76,400 on Program Power's *Killer Gorilla* – is this a record?

J A McDowall
Essex

XREF CURES

Sir, The variable listing program by Ian Graham published in November's *Acorn User* is an extremely helpful utility. Unfortunately, the program as published will operate correctly only with Basic programs that do not include assembler statements. Only the variables that occur before the first square bracket denoting an assembler statement will get listed. This is because the variable 'ass%' is not reset when the loop in line 650 is terminated. Consequently, the program can never get past line 290 when analysing subsequent data.

A further difficulty with this area of the program arises if the closing square bracket of an assembler statement happens to be the first character on a program line. In such a case line 650 fails to pick up this bracket, and again no more variables will be found as the program considers the remaining data to be assembly language.

A slight modification of the procedure concerned, as shown in listing 1 will overcome both problems.

Tony Snell
Scotland

Ian Graham replies: Tony Snell is perfectly right and his suggested amendment will correct the problem.

There is another error in the listing. In line 490 there should be a semi-colon after the zero in the VDU statement. Line 490 should read:

490 IF screen%=80 THEN MODE 3:VDU19;4;0; ELSE CLS

The effect of this error is to stop the page mode taking effect when displaying an 80-character screen.

```
630DEF PROCassembler
631REM ============
640 ass%=TRUE
650 IF B%<>93 THEN REPEAT:PROCread:UNTIL B%=93 OR len%=0
660 IF B%=93 THEN ass%=FALSE:PROCread
670ENDPROC
```

Listing 1. Modification to XREF utility

```
 10 REM Non-repeating random numbers
 20 REM version 1
 30 DIM NO(10)
 40 REPEAT
 50 FOR N=1 TO 10
 60 PROCrand
 70 NEXT
 80 PRINT
 90 FOR I=1 TO 10
100 PRINT;I,NO(I)
110 NEXT
120 UNTIL INKEY(0)=32
130 END
140
150 DEFPROCrand
160 LOCAL I
170 X=RND(10)
180 OK=TRUE
190 FOR I=1 TO N-1
200 OK=OK AND X<>NO(I)
210 NEXT
220 IF OK THEN NO(N)=X ELSE PROCrand
230 ENDPROC
```

Program 1

```
 10 REM Non-repeating random numbers
 20 REM Version 2
 30 DIM NO(10)
 40 REPEAT
 50 NO(10)=55
 60 FOR N=1 TO 9
 70 PROCrand
 80 NEXT
 90 PRINT
100 FOR I=1 TO 10
110 PRINT;I,NO(I)
120 NEXT
130 UNTIL INKEY(0)=32
140 END
150
160 DEFPROCrand
170 LOCAL I
180 X=RND(10)
190 OK=TRUE
200 FOR I=1 TO N-1
210 OK=OK AND X<>NO(I)
220 NEXT
230 IF OK THEN NO(N)=X:NO(10)=NO(10)
    -NO(N) ELSE PROCrand
240 ENDPROC
```

Program 2

RANDOM RECURSIONS

Sir, I was surprised to read that the production of non-repetitive random numbers in a given range 'can't be done'. This statement was made in the reply to Mr O'Brien on page 163 of the December issue, under the heading 'Comparing Notes'.

The enclosed recursive procedures, programs 1 and 2, will do precisely what Mr O'Brien wants.

Program 1 produces ten random numbers via PROCrand, and will go on doing so until you press the space bar.

Program 2 produces 9 numbers by PROCrand and calculates the last by subtraction. This method is normally faster.

Generalising for any integer n is easy. In programs 1 and 2 substitute the value of n for the 10's at lines 30, 50, 90 and 170 (or equivalent). In program 2 the line NO(10)=55 becomes NO(10)=n*(n+1)/2.

To understand how it works, refer to the McGregor & Watt article on recursion in the July issue.

George Hill
London

RANDOM LIST

Sir, In your reply to a query to J O'Brien on page 163 of the December issue, you implied that you could only achieve a ten number random output between 1 and 10 without duplication by delving into machine code.

I'm sure that you did not mean to give this impression as it can be achieved very easily in Basic as follows:

```
10 DIM A(10):X=RND(-TIME)
20 REPEAT
30 X=RND(10)
40 IF A(X)=1 THEN 70 ELSE A(X)=1
50 PRINT X
60 C=C+1
70 UNTIL C=10
```

The X=RND(-TIME) in line 10 is inserted so that the random generator will be set to a new value at every cold start.

R V Christophers
Brighton

COUNTER ARGUMENT

Sir, Mr J Revis had a query in the December *Acorn User* about spurious resetting of the AUTO counter. You replied that he probably had a faulty machine. This is, in fact, not so.

The problem is caused by changing mode with Ctrl. V or VDU22. These, unlike MODE, do not change HIMEM, which the Beeb uses to position its Basic stack. So, if the mode changed to requires more memory than the one changed from, HIMEM and the Basic stack will be left inside the screen memory area. This is normally only apparent as a few pixels near the bottom of the screen lighting up and occasionally moving about.

The AUTO counter is either stored in, or uses, the stack, so when it is scrolled off the screen the 6845 erases it, thereby resetting the counter (when software scrolling the system crashes).

The answer to the problem is either to use MODE or to reset HIMEM after a VDU22 (eg OSBYTE 133 (&85)).

J. Wookey
Dorset

TONGUE-TIED

Sir, I wonder if any readers with talkative BBC micros can help me. Having purchased the Acorn Speech System and been quite impressed with it, I tried to venture into the 'create your own words' section but to no avail. I cannot follow how the new word is broken down to create the data for the ROM to speak. To my mind the manual does not explain this.

Can anyone explain the missing link or, better still, has anyone written a utility program to decode words into speech data?

Meanwhile I am struggling in vain to enter the 'make Kenneth Kendall say rude words contest' but so far have only succeeded in making the micro grunt.

G R Stroud
Bedfordshire

See Ian Rowling's article in the January issue for some help.

CYPRUS CONNECTION

Sir, I would like to make some corrections to the answers you gave David Guest of London in your August edition about taking his BBC micro to Cyprus.

First, he would not need a transformer as mains voltage in Cyprus is exactly the same as in the UK. Second, although Cyprus TV uses the SECAM colour system almost all TVs sold or rented there have both the SECAM and the British PAL TV colour systems. In fact he would have to look hard to find a TV with only the SECAM system.

Barrett Kouyoumdjian
Nicosia, Cyprus

GEMINI'S TWINS

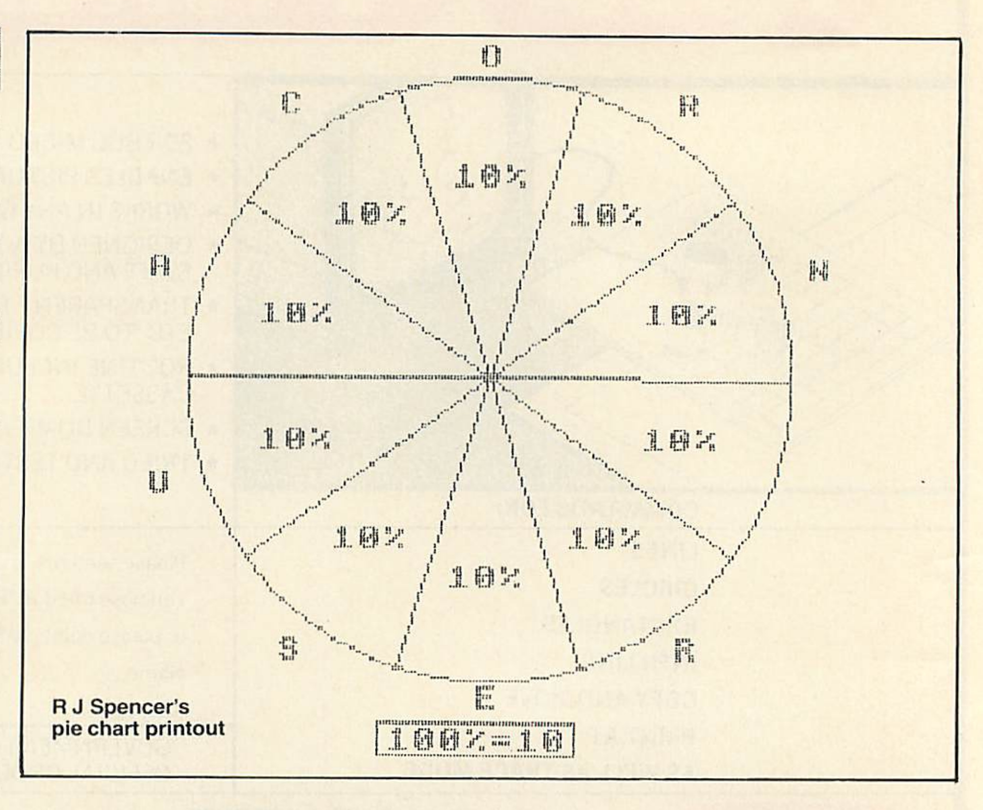
Sir, I was interested to read your review 'Battle of the Beebcalcs' (October issue) and, growing weary of waiting for the 'working' Computer Concepts version, purchased the Gemini Beebcalc together with Beebplot. I find both programs excellent, but am *amazed* that two programs which are designed to link should require different printer settings. This should surely be rectified by Gemini.

For those using Beebplot with an Epson printer set to auto linefeed may I suggest the following program corrections to remove the double linefeeds?

For cassette versions, list line 60 in each program, and change LDA#10 to LDA#0 (approximately halfway through the line).

If you have the disc version you need only change one program. First, *LOAD DUMP. When loaded, enter ?23555=0, then *SAVE DUMP 5B68+F3 . I don't know if these amendments are the same as recommended by Gemini to your reviewer, but they at least give circular pie charts, as you can see from the attached printout.

R J Spencer
Surrey



R J Spencer's pie chart printout

WATFORD DFS COMPATIBILITY

Sir, I am in receipt of your letter pointing out some problems your readers have had. First, let me say that Watford Electronics supplies only full spec and fully guaranteed products. The company has been established for 11 years (perhaps one of the oldest companies advertising in *Acorn User*) and has satisfied customers all over the globe.

One of your readers had problems with a disc which he returned to us. There was nothing wrong with the disc as we formatted it first time without any hitch.

A possible cause of the problem the reader has with the Watford DFS is that he has an earlier version, 1.1 or 1.2. If he would like to return it, we will gladly exchange it (free) for DFS 1.3.

We describe our DFS as compatible with the Acorn DFS on the grounds that our system supports all the entry points and memory uses that Acorn supports. Software houses tend to use illegal programming methods such as running PAGE at &1100 and reading DFS memory directly to access file names. Acorn does not support these techniques and thus we do not need to support them to be compatible.

The point is really that there are two ways of writing BBC software, the way that usually works, and the way that follows the programming rules laid down by Acorn. If the software houses continue to sell products that are not compatible with the correct use of the machine's memory and OSGBPB etc, it is they who are failing to provide software compatible with the Acorn specification. It is remarkably easy to write software that will only run on Acorn's DFS 0.90; it requires only a little more effort to ensure the program will run correctly on any DFS following the specifications given in the *User Guide*, Acorn DFS manual, sideways ROM information leaflet, etc. There is no guarantee that many of the software products on the market will in fact run on later versions of Acorn DFS.

Our DFS version 1.3 will successfully run all Acornsoft games discs that we have seen. If the software your reader requires is on discs that do not follow the correct programming methods, I would recommend he buys this software on tape and transfers it to disc, which is usually possible.

It is, we believe, untrue to say that a lot of disc-based software will not run on our system as we have encountered no problems using Acornsoft games discs and these are surely the most common.

I hope my above explanation clarifies the disc problem and I look forward to receiving your comments.

Nazir Jessa
Managing Director
Watford Electronics

CAN EXTEND

Sir, To help Jim Price (December letters), who has received a 'Can't extend' message trying to add to a file on disc, here is one way of clearing space: Type *INFO*, and see how the files are located on your disc. You may find that the file you are trying to add to is TA1, located, say, from 002 to 103. But another file, say TB2, is located from 104 to 124. Quite a small file is sitting on top of your long one and preventing it from growing.

Take a spare, empty disc and *COPY onto it first TB2 and then TA1. TA1 is now on top, and it can be extended to the end of the disc.

The way to avoid this sort of thing altogether is to find out how long each file is ever likely to be, and, right at the start, establish dummy files to those full lengths (for instance, print 120 records, each of STRING$(100," ")). Your new data in a file will then simply overwrite the dummy entries, and will not have to extend the file at all.

David Lewis
Oxford

BASIC FLAW

Sir, The tip on page 52 of the October issue about saving a Basic code as a machine code so that it can be started with a *name was very helpful. I've found, though, that it has one flaw. If the Basic program references TOP, LOMEM and HIMEM then it won't work, because these areas haven't been set.

It is easily cured by putting an END into the input buffer before the RUN, in exactly the same way.

Eric Robertson
Edinburgh

BIG BANG

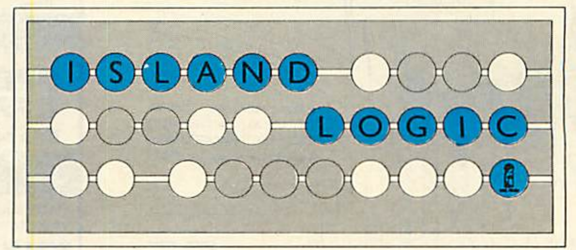
Sir, Help! Anyone worked out an effective program for a nuclear explosion?

Alan Frost
E Sussex

The Space Invasion is over!

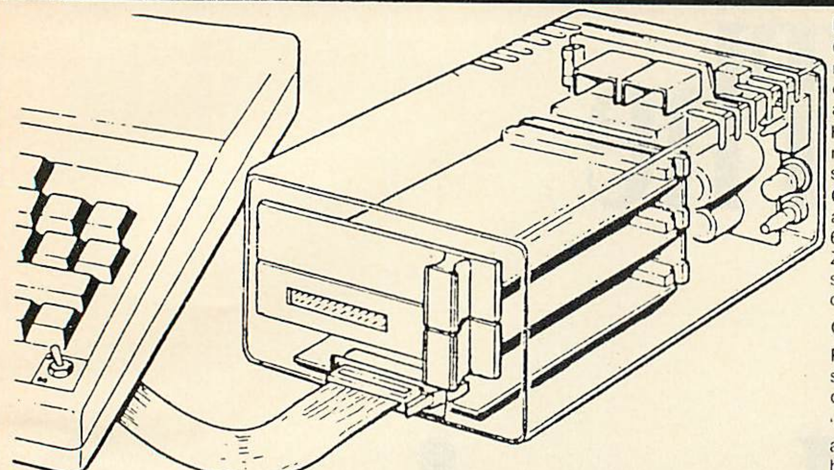
It was a deserved victory, the alien attacks numbing an entire generation of terrestrial brains.
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MY THREE-WEEK BUGBEAR

Sir, There are two types of computer users – people who enjoy fiddling with them for hours on end and people who want to use them to increase their efficiency so that they can spend hours fiddling with something else! I belong to the latter group, regarding the computer as a tool, not a toy. A survey in the USA determined that 80% of computer owners rely on available software and know nothing about programming. They are too busy earning the money some other way to spend on computer equipment.

I buy magazines for news about hardware, for information about programming techniques and to type in the software. Therein lies the problem. As a magazine editor you are going to have to find a way of providing bug-free listings. There must be thousands of readers like myself who need the software to become more efficient but do not have three weeks to spend debugging.

The standard comment about these listing errors is that it's good for you. Makes you learn more about your computer. This is nonsense. After ten hours of fiddling that I can ill-afford, the computer is still just saying MISTAKE. I feel like smashing the VDU, five years have been removed from my lifespan and I vow never again to open another magazine. As for learning, if those ten hours had been spent reading a book on programming something would have been learnt, and anyway I can learn far more from analysing a program that actually works than from fruitlessly debugging something that won't.

You all admit debugging is difficult. Don't you realise that to debug someone else's program is even more difficult, that if you do have the necessary skill it is far easier, faster and more efficient to write your own program?

One more gripe. Program writers take note: please debug your program before sending it to the magazine. Please tell us how to use the tool you have listed. Remember, those who know how to *SAVE your listing and CALL it from the depths of RAM could probably have made their own program.

By the way, I am writing this letter on a BBC with View and Citoh printer which is a marvellous tool now that finally almost everything is working.

Rod Borland
South Africa

A LESSON FOR TEACHERS

Sir, I write with reference to Helen Cole's letter in the November issue. I also bear in mind the articles written on women (or the lack of them) in computing.

At the age of 14, I have just started my 'O' level computer studies course. In the group I belong to I have found that the girls outnumber the boys quite considerably and take a considerable interest in the subject. This is, of course, contrary to the popular belief that most women shy away from computers in favour of other more ladylike activities.

Now for Ms Cole's letter. I'm afraid I must ask myself (very carefully) whether Ms Cole is working for women's lib? Probably not, but even so I feel I must disagree with some of her comments. On my computer course so far we have covered several aspects of computers and only a small proportion (around 35-40%) of our time is spent using the BBC micros which the school owns. The rest of the time is used looking at how computers work and how mainframe and mini-computers are set up. In her letter Ms Cole says that most youngsters in school today haven't the faintest idea what mainframes, minis and business micros are used for, and have never heard of any language other than Basic. In my experience this is not the case. We *have* had languages other than Basic mentioned in our lessons, such as Forth, Cobal, Comal, Algol and Fortran and it has been stressed that these languages are superior to Basic in many respects.

Lastly, on the subject of micros in schools, I find that some teachers do not take them seriously enough. One (incidentally a woman) refers to BBC B micros as toys, and yet anyone not doing what they are told to on a computer is then told to 'stop playing'. Surely, toys *are* for playing with. So to all the teachers out there I say: 'Please treat micros as proper computers and not just as toys!'

Stephen Green
Surrey

DOCTOR'S DILEMMA

Sir, I am prompted to write as a result of seeing the *Dr Who* game at number 6 in your software chart.

I bought this game as a Christmas present for my son on the basis of the good names of the BBC and *Dr Who*. Then I read Jeremy Vine's review in your December issue!

Rather than leave the game unviewed until Christmas day I thought it would be wise to see if it could be as poor as described. It was indeed as poor as the review suggested. What was worse was that the 'adventure' in no way kept faith with the spirit of *Dr Who*.

I was absolutely horrified that I had been misled by the names on the packaging enough to buy before seeing a review. I immediately sent the whole sorry mess back to the BBC.

How many others have been disappointed, I wonder?

Mike Pratt
York

Dr Who's decline, page 13

NORMAL SERVICE

Sir, Unfortunately, Martin Phillips in Hints & Tips (December issue) has repeated an error in the BBC *User Guide*. If @%=10 is used to reset the machine to 'normal format' then errors can occur, but if the correct @%=2314 is used then sensible results are produced, as shown by program 1.

Peter Helsdon
Essex

```
10 @%=10
20 PRINT "@%=10"
30 PRINT "10/1000=";10/1000
40 PRINT "293/1000=";293/1000
50 PRINT
60 @%=2314
70 PRINT "@%=2314"
80 PRINT "10/1000=";10/1000
90 PRINT "293/1000=";293/1000
100 END

>RUN
@%=10
10/1000=9.99999998E-3
293/1000=0.292999999

@%=2314
10/1000=1E-2
293/1000=0.293
```

Program 1

CONTROL CODE FOR CASSETTE PORT

Sir, In answer to the letter from Mr T Smith in the December issue of *Acorn User* concerning direct control of the cassette port, I think the following code should help:

```
*FX5,2         : Select RS423
*FX8,3         : 300 baud
?&FE10=&AD     : Switch to cassette:
                 start motor
```

Characters may now be output to the tape in a direct ASCII form by using VDU2 to turn on the printer, after which all screen output will be copied to the cassette. Specific words can be output using VDU2 and VDU3:

```
eg  VDU2
    PRINT "HELLO"
    VDU3
```

To use the tape at 1200 baud, change the poke above to ?&FE10=&89.

Also, I too have recently had problems with a jumping screen display (Brian Hodgson, 'Jumping Aliens'), which has cost me a new modulator. On fitting the new one, I discovered that several of the power leads to the circuit boards were not making proper contact, and as a result the far side of the board, where the modulator is located, was only receiving aobut 4.7V, causing the picture to bounce around a great deal, apparently at random.

Incidentally, in answer to Charles Painter's *Planetoid* claim (December issue), my high score on this excellent game is 128,000.

Richard Porter
London

Further information on direct control over the cassette port can be found in the *Advanced User Guide.*

PRIMARY CONCERN

Sir, I was greatly interested in Alistair Ross's account of children gathering and using data (December issue). I feel, however, that his plea for a database program for BBC micro users similar in capability to the one he uses from ILEA over-states the deprivation somewhat. I have no knowledge of Scan or MicroLeep, but I have found the program Inform from the Nottinghamshire Computer Centre perfectly adequate for our purpose using a BBC B machine.

Part of my work is in a primary school which is, at present, using the Croydon IT Project materials. The 10-year-olds concerned have, with no undue difficulty, set up their database of facts about themselves (10 fields), typing in their own details and carrying out simple searches. They can also conduct a search involving two fields using AND/OR.

With secondary pupils the same program is put to fuller use with data, such as details of road traffic accidents, already gathered by professionals. The Tadis package produced by the Notts Computer Centre is an example of such data (using 20 fields) with which pupils can test the hypotheses they form from a survey of the general literature on the subject of factors in road accidents.

Perhaps the most striking use of Inform has been in connection with our most recent work on the Croydon Project: the study of the growth of this area using census returns. The information has been copied from these forms and entered into 10 fields and the database established to enable the children to make the necessary searches to build up an accurate picture of life in the 1880s in 'the village of Southbourne'.

It is encouraging to read of good case studies such as 'Conkers and Statistics in the Classroom'.

O P Alexander
Dorset

EPROM/ROM SWITCH

Sir, I have an Acorn DFS (version 0.90) and a 1.0 operating system. Both appear to be in EPROM. Although I have read a great deal about the exchange of 0.1 EPROM operating systems for 1.2 ROM versions, I have heard nothing about any arrangements for exchanging DFS EPROMS and the associated 1.0 OS EPROMS for ROM versions. Has Acorn announced what their policy will be?

Secondly, is it possible (or advisable) for a user to replace his own 1.0 OS by the 1.2 ROM, bearing in mind the complications of the piggy-back mounting board? Is this simply plugged into one of the sideways ROM sockets, or are they soldered connections to be unmade?

M J Matthews
Herefordshire

The 1.0 MOS will not be replaced except on installation of a product/service by an Acorn dealer. There is no DFS except 0.90 in EPROM currently, so again no replacement will be done.

It is not difficult to replace a 1.0 EPROM with a 1.2 ROM: no soldering is required, just extract the 1.0 and insert the 1.2. Acorn does not do this replacement free of charge.

ARRAY ERROR

Sir, I refer to Ian Copestake's article in July on array handling which has errors. In particular in discussing the definition of the function keys he has made an unnecessary complication.

With the keys empty, the definition of key 0 starts at &B11, *not* &B12. Thus there are only the 16 expected key definition offsets. In his example of using *KEY0 to delete on screen and printer, one must force using the ? operator – omitted – and the right memory:

```
*KEY ¦ A ¦ A ¦ A
?&B11=127
?&B13=127
```

Do try your programs *after* typesetting.

Jeffery Lewins
Cambridge

FIT TO RUN?

Sir, Since purchasing my model B in May 1983, I have experienced a number of minor problems with my machine that have been rectified very efficiently by my local dealer, Northern Computers of Frodsham, but I seem to have become quite paranoic about the thing.

When it doesn't do what I want, is it me or the machine?

Are you aware of any program that checks out the micro's system and pronounces them OK or otherwise? If not, could I suggest that it may make the basis of a future article.

Thanks for a super magazine.

John C Pitfield
St Helens

The FIT (final inspection tester) program for the model A is supplied to Acorn dealers to do just this. It tests most aspects of the machine without using any extra hardware. It would be possible to modify this to drive model Bs (though some interfaces really need extra hardware to test them fully).

We'll see what we can do about getting FIT published, or something similar.

TORCH LIGHT

Sir, You were kind enough to publish my letter in the November issue asking for other users of the Torch Disc Pack to contact me. The response from mainly bemused users who felt themselves to be friendless has convinced me of the need for an independent user group dedicated to Torch.

The aims of the group are to be: to provide technical and moral support; keep members up to date with relevant news, and ensure the supply of (modestly priced) software in Torch format. If, therefore, any Torch users feel that their batteries are running low, there is a light at the end of the tunnel!

They should write to me for full details at: 69, The Avenue, Wembley, Middx, HA9 9PH. An SAE will be appreciated and ensure a speedy reply.

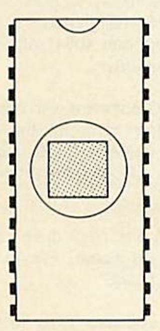
Grahame Perchick
Wembley



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BBC software cassettes. £5 each. Including Acornsoft, Micro Power, IJK, Software Invasion, Postern and others at lower prices, all originals. Telephone 01-836 2351 at weekends after 8pm. Also pair of joysticks £6.

BBC disc software. 'Index It' for magazine, photo, stamp index, etc. . . . 'Graphix' drawing program with 15 shades on mode 1 screen. £15 each. To D .J. Williams, 5 Belmont Avenue, London N9 7JL. 01-804 0697 5-10pm.

SOFTWARE for BBC B for sale. Acornsoft: Planetoid, Quicksilva: Wizard, all originals, £2 each. Please write to S. Hawkins, Manor House, Clayesmore School, Iwerne Minster, nr Blanford, Dorset. Swaps will be considered.

BBC MODEL B. 1.2 OS, Basic 2, leads, etc. Fitted with Wordwise ROM plus manual, condition as new, together with many games. Selling for financial reasons. £400. West Malling (0732) 848436 after 6pm.

BBC B modem plus Micronet software, £50. TRS-80 model one level two plus interface plus 48k RAM plus monitor plus cassette recorder plus graphic unit plus software plus books. Sell computer system for £475. Ring 061-368 7145.

MICROVITEC standard colour monitor, five months old, only £200 ono. Will *deliver locally*. Grahame Benson, Lichfield (Staffs) 23919.

ATOM software to swap or sell. Air Attack, Frog Jump, Astro Warrior, Swarm, 3D Asteroids, Lunar Lander, Warlords, Constellation, Atomstore, Microbudget, Starburst, Life package. £4 each. Phone Andrew, Meopham (0474) 812704.

BBC MODEL B. Pascal (ROM), 4 games (Planetoid, Arcadians, Monsters, Demon Decorator), tape recorder, monitor stand, only 2½ months old, worth over £540. My bargain price of only £387. Contact Ramin 4523878 after 6.30pm.

UNEXPANDED Atom with PSU manual. Boxed. £75 ono. 26 Duncan Way, Loughborough, Leicestershire.

32K PRINTER buffer for any Epson printer, £99. BBC-Epson printer cable, £9. Dual Mitsubishi ½-height 800k disc drives with psu, cables, etc, £499 (all as new). Manchester (061) 799 9845 evenings.

BBC 32K. Lots of software (including Defender, Snapper, Arcadians, Rocket Raid, Adventures, etc) magazines, books, leads and cover. Very good condition. Little used. £275 ono. 01-393 7592.

ATOM 12k + 12k, toolbox and word processor ROMS plus 4-way EPROM board, new power supply. Manual, Getting Acquainted and magic books, games, Acornsoft database cassette, £150 ono. Horsham 66553 evenings and weekends.

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ATOM 12 × 12 fitted FP ROM, Ross utility BBC Basic selector board, printer via ex-Post Office – printer with interface, Manuals etc. All working well. Separate regulated power unit. All for £150 collect. Phone 0843 582719.

WALLIES ignore ads like this! Original secondhand software. Music Editor £5 (System). 747 Flight Sim, £4.50 (Doctor Soft). Both 32k Beeb. Both with full instructions. Tel: 051-336 2812 after 6pm.

ATOM 12k+ floating point ROM, 20 or more cassettes with various games, 2 × games books, manual, PSU, leads, etc. £140 ono. Ring Downland 52777 evenings.

ATOM cassettes games pack 6, £4. Games pack 9, £4. Intro pack, £6. Program Power: Invaders, Adventure, Lunar Lander, Sketchpad, £2 each. Atom books, £2 each. Harris, Burton on Trent (0283) 42558.

AMERICAN computer magazines: three for £4, or four for £5, postage paid. G. Smith, 84 Edenfield Gardens, Worcester Park, Surrey KT4 7DY.

BEEB SOFTWARE. All originals. Croaker, Gunsmoke, Constellation, Frogger, Spacemaze, Polaris, Timetrek, Golf, Gorilla, Munchyman, Adventure, Pharaoh, Alien Destroyers, Space Pirates, Memo Calc. Cost over £100 sell for £30. Phone (St Austell) 072681 3375.

AMERICAN personal/hobby computer magazines. Three for £4, or four for £5, postage included. Wanted: *Acorn User* Oct 1982 to March 1983. G. Smith, 84 Edenfield Gardens, Worcester Park, Surrey KT4 7DY.

BBC PROGRAMS for sale. Program Power – Moon Raider, Chess, Killer Gorilla, Moonbase Alpha. Doctorsoft – 747 Flight, Spectre Slayer. ECFG colour graphics utility. All originals. £2.50 each. Phone (08926) 62540 evenings.

BBC SOFTWARE to swap. I have a large selection and its (growing) over 250. All the best makes: Acorn, Superior Soft, Program Power, IJK, Bug-Byte. Tel: Grimsby 74584 and ask for Martin.

SWAP BBC software? Write to A. Jackson, 5 Denbigh Avenue, Cleveleys, nr Blackpool, Lancs FY5 3PT.

PROGRAMS for BBC. Mostly games. Also Forth and Lisp and others. All originals in excellent condition. Tel: Rickmansworth (Herts) 775583.

BBC MICRO software for sale. Acornsoft, Micro Power, IJK, BBC-Soft, all originals. Many others. Official Acorn joysticks (pair), £6. Software £5 each. Telephone 01-579 9746 weekdays and 01-836 2351 weekends between 6-10pm. Over 30 tapes available.

DISC DRIVE, £120 ono. Tandy unit with built-in PSU. Interfaces with BBC micro (See *Acorn User* January 1983). Call after 5pm or write to: Dave Edwards, 28 Princess Road, London NW6.

UK101 cased built-in tape deck, Ceqmon mini EPROM board, toolkit assembler on tape, £80 ono. Or will sell separately. Faller, 25 Manor Road, Barnet, Herts. 01-449 1808.

HELP! Required with my Atom. Basic tuition needed. Also having loading problems. Anyone willing to help please ring Gosport (Hants) 81841.

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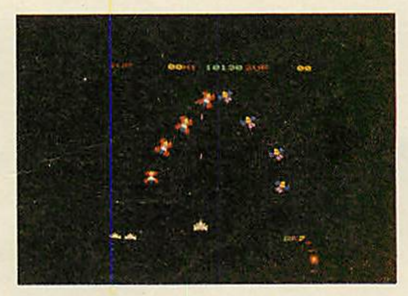
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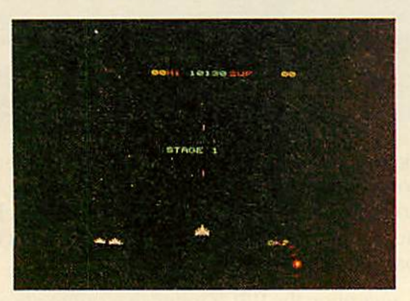
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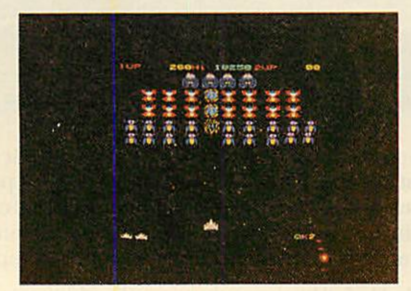
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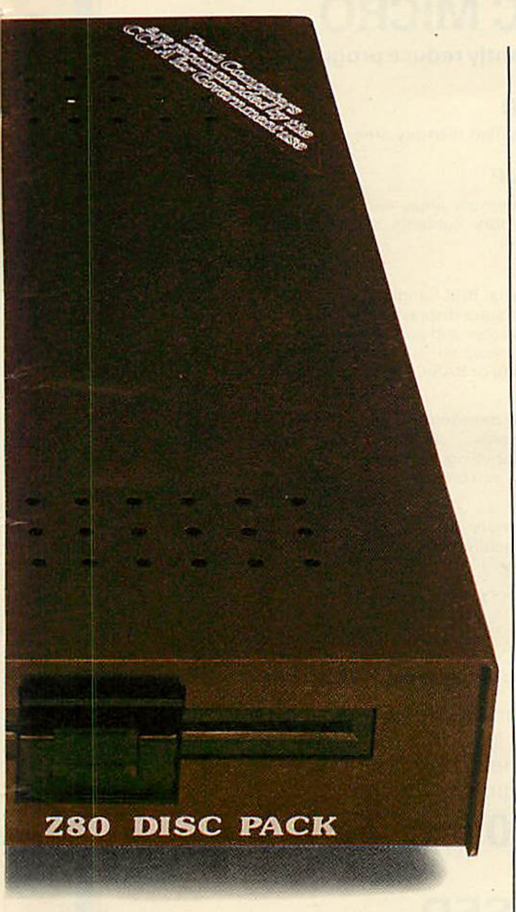
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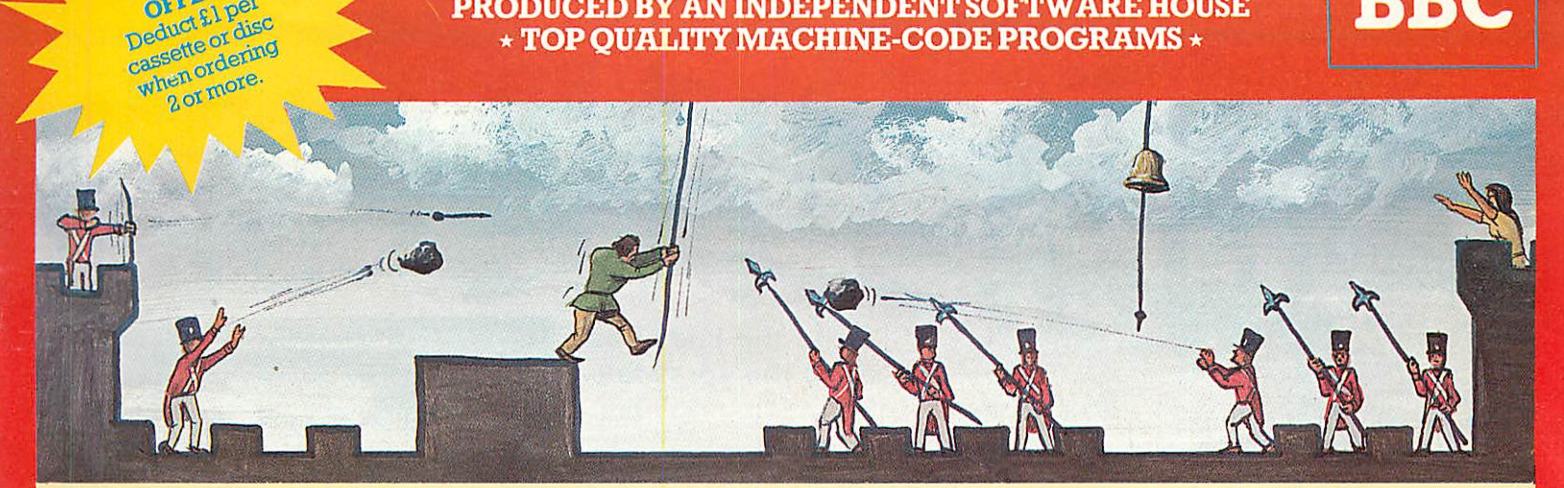
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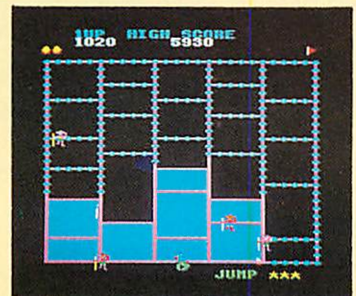
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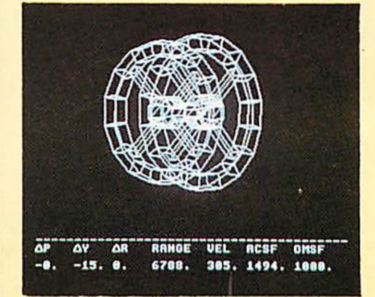




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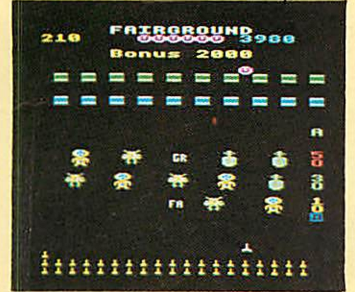
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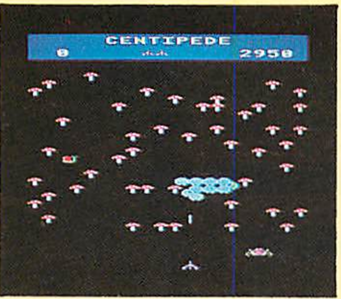
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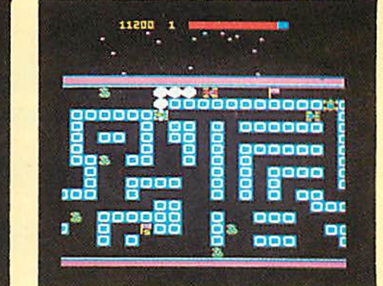
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